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PROJECTIONS OF LAND USE AND SOIL LOSS IN THE CHOWAN-PASQUOTANK RIVER BASIN

CHOWAN-PASQUOTANK RIVER BASINS STUDY

U.S. DEPARTMENT OF AGRICULTURE

Soil Conservation Service
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By
Clayton Ogg
and
Ralph Heimlich

Northeastern Resource Program Group
Natural Resources Economics Division
Economics, Statistics, and Cooperatives Service
United States Department of Agriculture
Broomall, Penna.

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Abstract

This report presents land use and soil loss projections for the Chowan-Pasquotank River Basin and describes inputs to the linear programming model. Total production or demand for 1990 and 2020 is based upon past trends in regional production shares of national and export markets. Other model inputs include basin yields and soil losses on soil groupings and budgeted costs. The model is designed to analyze economic and environmental impacts of soil and water conservation plans for the Basin.

Key Words: Model, Linear Programming, Demand, Environment, Conservation, Yield, Budget, Productivity.

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INTRODUCTION

Future conservation needs for the Chowan-Pasquotank River Basins of Virginia and North Carolina are very much affected by changes in the intensity and location of agricultural production. Both of these are affected by trends in the adoption of new technologies, such as improved seed varieties and double cropping, as well as new approaches to drainage and land clearing.

Agricultural production for a large river basin is also dependent on changing national and international demands and upon trends in regional production shares of total U.S. production. Land use and soil loss projections for the Chowan-Pasquotank study therefore make use of OBERS crop production projections for subareas of Virginia and North Carolina.[1/] These are not suggested as goals, but are rather viewed as the likely outcome if present programs and productivity trends continue and if the Chowan-Pasquotank Basin continues present trends in meeting its historical share of national demands.

Basin level baseline projections for individual commodities are proportioned out of the OBERS regional projections, based upon the same shift-share procedure which produced the original state and regional projections from OBERS. Basin commodity acreages are then allocated to Soil Productivity Groups whose total cropland area is related to current land availabilities or to estimates of future potential for converting

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1/ OBERS projections were developed for this type of use by what was then the Economic Research Service of the U.S. Department of Agriculture and the Department of Commerce's Office of Business Economics. They involve a disaggregation of national demand projections to states and Water Resource Subareas. Alternative projections are based on assumptions about exports and population growth.

more acreage to cropland (Parks, 1975).

Allocating the baseline outputs and land uses to Soil Productivity Groups (SPG's) is an arduous task that is, nonetheless, considered very practical to both the inventory and the planning phases of the Chowan-Pasquotank study. Rapid land clearing in some areas and other changes in the location of production accentuate the need for detailed projections. Since the SPG's are created by grouping soils with similar management needs and productivities, projections of land uses by SPG are sufficiently detailed to project soil loss and other environmental variables. Projections of soil loss are based upon local crop management and tillage practices as they interact with soil class characteristics (including erodibility, slope, and slope length).

The economic basis for allocating land in each SPG is a set of detailed cost budgets and yields which determine how competitive each SPG is for the various economic activities. A linear programming (LP) model is used to find the set of activities which minimizes costs of meeting output demands. It is assumed that farmers are using land so as to maximize their profits and that the alternative budgets developed for each crop, on each SPG, include the management techniques which will be used by farmers in 1990 and 2020.

Projections of production and land use by SPG indicates problem areas and the relative future importance of lands with various treatment needs. However, the primary objective of this type of detail is to have a basis for comparing the effects of plans. The linear programming model used here to project land use and soil loss and production costs can also be used to examine how Basin farmers would be affected

by various tillage restrictions, rotation restrictions, alternative production goals, and land preservation goals. Environmental and economic effects can be compared in each case. Thus, the model developed here is to be used later for comparing plan alternatives which may be suggested by federal and state agencies and by the public.

DEVELOPMENT OF BASIN LEVEL DEMAND PROJECTIONS

In the absence of any plans or efforts to change past trends, the Basin's market demands will be shaped by trends in national demand and changing regional production shares. Thus, amounts of important agricultural commodities likely to be produced in the Basin in the future were projected by disaggregation of regional projections from OBERS medium and high export projections.[1/] The resulting projections of future production by crop will serve as the initial demand constraints to be met by the planning model.

As a first step, production by commodity in the Basin and in OBERS Water Resource Subarea 301 were obtained from OBERS back-up data and the Census of Agriculture for 1954 to 1974. Adjustments were made to allow for the small Basin counties not contained in WRS 301 and for WRS 301 counties not in the Basin (See Figure 1). Ratios of Basin production in WRS 301 to total WRS 301 production were computed for each year and used as data points in a curvilinear regression function (Spillman function), which is identical to that used in disaggregating the OBERS projections to WRS levels. The proportion of WRS 301 production

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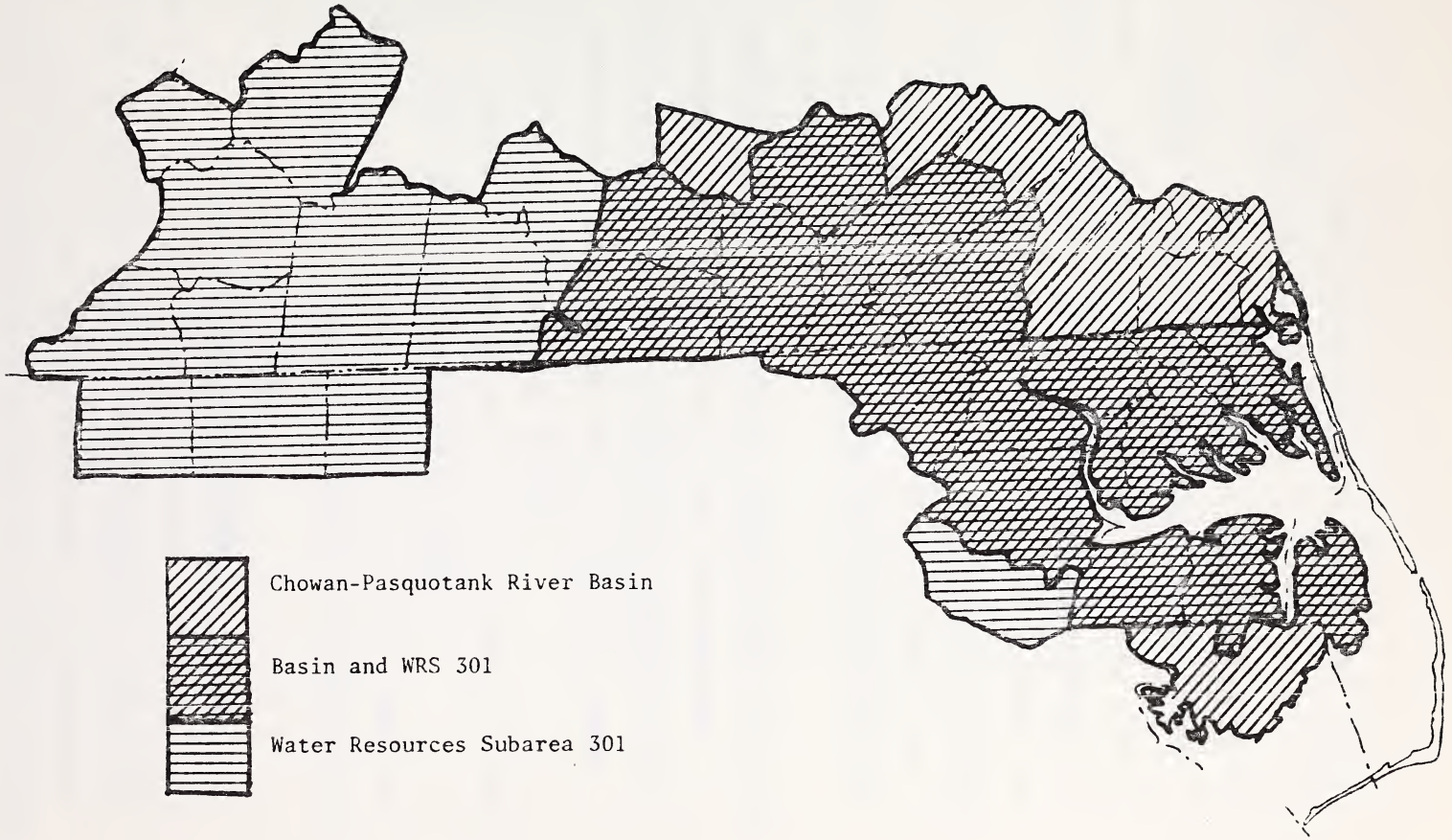
1/ These two sets of projections are based on different assumptions about growth in world demands, which, of course, have varied substantially in recent years.

Figure 1--Chowan-Pasquotank Basin and Water Resources Subarea 301



used by crops which are likely to be produced in the Basin for selected years from 1990 to 2020 were thus obtained.

Multiplication of these proportions by the respective OBERS projections of production for medium and high export assumptions gives crop production in that portion of the Basin also in WRS 301. Since part of the Basin is outside of WRS 301, the second step requires a similar set of projected proportions showing the fraction of Basin production in WRS 301. (Figure 1 indicates most of the Basin is contained in WRS 301.) Division of projected production in Basin WRS 301 counties by the proportion of Basin production in WRS 301 yields projected crop production in the Basin.

As an example, if OBERS projections for soybeans in WRS 301 in 1990 were 10,000 bushels and the projected ratio of WRS 301 production in Basin counties were 20% and the ratio of total Basin production which originates within WRS 301 were 70%, the projected demand for soybean production in the Basin in 1990 would be given by:

Step 1: 10,000 x .20 = 2000 bushels (in the Basin counties of WRS 301)

Step 2: $\frac{2000}{.70}$ = 2857 bushels (total Basin demand).

Since the Chowan Basin generally accounted for most of the production in WRS 301, this procedure provides the Basin LP model with demands that are highly consistent with OBERS projections.

Trends and Projections of Demand

Recent trends in crop and livestock production and projections of demand to 2020 for the Basin generally show a substantial increase in high-value grain and oil crops destined for national and international markets (Table 1). Accompanying this are reductions in locally consumed crops used for animal fodder.

Table 1--Recent crop and livestock production and projected demand, Chowan-Pasquotank Basin, 1964-2020

Crop	Unit	1964	1974	1990	2000	2020
		Thousands				
Hay	Ton	76.9	54.7	64.7	64.9	61.4
Corn for Grain	Bu	19,708.6	35,716.9	36,148.8	49,732.3	59,912.8
Peanuts	Lb	363,910.1	466,259.4[1/]	904,119.6	1,024,377.3	1,098,084.9
Soybeans	Bu	5,946.8	9,705.6	25,051.7	33,733.4	36,550.5
Silage	Ton	182.5	NA	162.3	143.0	104.3
Tobacco	Lb	69,627.3	49,789.9	67,256.4	66,986.7	83,535.2
Wheat	Bu	1,725.9	3,300.0	3,324.3	3,612.5	3,847.7
Grain Sorghum	Bu	179.4	345.4	847.0	1,021.9	1,116.6
Beef and Veal	Lb	42,310.0	NA	71,959.8	79.131.5	93,110.0
Pork	Lb	141,548.9	NA	252,957.2	274,957.2	325,714.5
Chickens	Lb	5,550.6	NA	3,788.2	3,788.0	2,931.3

1/ Class 1-5 farms only (OBERS)

NA Not Available

Heightened world-wide demand for food grains and oilseeds is reflected in the dramatic increases in production of corn for grain, wheat, and soybeans between 1964 and 1974. Demand for these commodities is projected to remain at high levels, and grow steadily, through 2020. While less important as a percentage of total demands, grain sorghum is also projected to increase steadily.

Demand for traditional field crops of the region has also been projected to increase in the future. Peanuts and, to a lesser extent, tobacco will be grown in the area in increasing amounts. The future of tobacco demand has been clouded recently, reflected in the decline in production from 1964 to 1974.

Both hay and silage production is expected to decline from present levels due to increased competition for cropland from other crops. Production of hay is likely to increase slightly in the short-term.

DEVELOPMENT OF YIELD PROJECTIONS

Yields by crop and soil productivity group are needed to project the land resources needed to meet alternative demand situations. The yields used in the model are developed by projecting composite yields from historical data and applying the projected composite yields to the SPG's. Resulting projections are then compared against current high management yields, involving the best technologies now available, to insure realistic estimates.

Historical data on yields by state and by crop for 24 years (1947-1970) were developed by ESCS as supporting data for the 1972 OBERS

projections. These data for Virginia and North Carolina were fitted to a curvilinear regression equation (Spillman function) to obtain projected yields for the 1980-2020 period. Relative production by crop of the Virginia and North Carolina portions of the Basin was used to compute projected composite Basin yields as weighted averages of state yields. As an example, computation of the 1980 composite yield for soybeans is shown in Table 2. Table 3 shows the composite historical trend and projection of yields for the major crops in the Basin.

Current normalized yields, reflecting the existing distribution of technology in 1970, were developed for soil productivity groups in North Carolina by John B. Hungerford, and J. Hall Campbell, State Resource Conservationists, SCS; Emmett R. Waller, Jr., Conservation Agronomist, SCS; and John R. Parks, ESCS. These yields were increased according to the trends in composite yields for the Basin developed above to obtain projections of normalized yields by crop and SPG for the Basin. Thus, the same pattern of growth in yield is applied to the varying levels of yield which were associated with soil productivity, as reflected by the SPG's. Projected normalized yields by SPG are shown in Table 4. Projected normalized yields for 1970-2020 are in Appendix B.

To check the reliability of projected yields, they were compared against high management yields for North Carolina, developed at the same time as the normalized yields. "High management" yields reflect the potential production per acre which could theoretically be realized if the most advanced agricultural practices now used were adopted by all producers. If projected yields far outstripped high management yields over the projection period, this would imply both the adoption

Table 2--Computation of composite soybean yields, Chowan Basin, 1980

	Virginia	North Carolina	Basin
1980 Projected State Yields	22.90 BU/ACRE	29.23 BU/ACRE	--
1970 Production (Basin Counties)	3,391,072 BU	5,561,359 BU	8,952,431 BU
1970 Production Weights (State Production ÷ Total Basin Production)	.38	.62	1.00
1980 Projected Composite Yield	.38(22.90 BU/ACRE)+.62(29.23 BU/ACRE)=26.8 BU/ACRES		

Table 3--Past and projected composite yields, Chowan Basin, 1947-2020

Crop	Unit	1947	1950	1955	1960	1965	1970	1980	1985	1990	2000	2020
Corn-Grain	Bu.	33.4	38.6	35.7	48.8	69.1	57.7	79.0	84.8	90.2	99.6	114.3
Soybeans	Bu.	15.0	17.1	17.2	22.5	23.3	22.1	26.8	28.1	29.2	31.3	34.5
Wheat	Bu.	17.5	17.0	24.4	25.1	29.7	43.7	43.7	46.9	49.9	55.0	63.1
Peanuts	Lb.	1140.2	1359.4	1354.2	1816.4	2484.0	2874.0	2886.0	3069.0	3238.0	3536.0	4003.0
Tobacco	Lb.	1130.0	1367.2	1423.6	1731.5	1825.6	1981.6	2320.0	2450.0	2570.0	2784.0	3120.0
Hay	Ton	1.0	1.2	1.2	1.4	1.4	1.6	1.7	1.7	1.8	1.9	2.1
Silage	Ton	9.4	9.8	9.2	10.8	12.7	12.9 1/	13.9	14.7	15.6	17.4	21.6
Sorghum-Grain	Bu.	3.0	3.6	3.4	38.0	42.4	46.0	64.2	69.7	74.8	83.6	97.3

1/ 1968 yield

Table 4--Projected normalized yields by crop in each SPG, 1990

SPG	Soybeans (bu/acre)	Wheat (bu/acre)	Tobacco (lbs/acre)	Peanuts (lbs/acre)	Hay (ton/acre)	Corn Silage (ton/acre)	Corn for grain (bu/acre)	Sorghum for grain 1/ (bu/acre)
1	0.0	50.8	3223.8	0.0	1.6	16.7	103.0	0.0
2	0.0	39.7	2900.8	0.0	1.5	13.4	85.5	0.0
3	0.0	0.0	2579.3	0.0	1.5	12.8	78.3	0.0
4	0.0	50.8	0.0	0.0	1.7	16.7	103.0	0.0
5	0.0	0.0	0.0	0.0	1.4	10.9	68.1	0.0
6	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
10	29.4	50.8	2369.1	0.0	1.9	16.0	97.9	77.7
11	25.2	46.6	2303.1	0.0	1.6	14.7	88.6	75.9
12	21.0	42.3	2105.8	0.0	1.8	11.5	68.1	69.0
13	29.4	0.0	0.0	0.0	2.3	16.7	97.9	80.2
14	18.5	38.1	0.0	0.0	1.9	9.5	56.6	62.2
15	21.0	0.0	0.0	0.0	1.7	10.3	61.7	0.0
16	0.0	33.9	0.0	0.0	1.2	11.5	66.9	55.2
17	16.8	21.2	2237.3	0.0	1.2	6.5	51.4	0.0
18	37.1	50.8	3092.9	2920.1	2.5	17.9	113.3	89.8
19	25.2	38.1	2500.5	2406.1	2.2	12.2	77.1	69.0
20	33.7	50.8	2763.7	2342.0	2.3	14.7	116.3	89.8
21	25.2	38.1	2237.3	0.0	1.5	14.1	66.9	0.0
22	25.2	42.3	2616.4	2586.4	2.2	14.7	82.4	75.9
23	37.1	50.8	2632.3	2252.7	2.2	17.9	123.6	0.0
24	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
25	21.0	0.0	1971.6	2252.6	1.5	10.9	66.9	0.0
26	35.3	46.6	0.0	0.0	1.9	17.3	108.1	0.0
27	37.9	46.6	0.0	0.0	2.1	14.7	113.3	0.0
28	16.8	0.0	0.0	0.0	1.5	0.0	56.6	0.0
29	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0
30	16.8	0.0	1863.5	1668.6	1.4	0.0	51.4	0.0
31	21.0	29.7	0.0	0.0	1.4	0.0	92.7	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1/ Computed from North Carolina yields only
Source: APPENDIX B, TABLES B-1 through B-8

of current best practices and the discovery of more productive technologies than are known today. Since the prediction of technological advance is a risky business at best, a more conservative forecast would have yields consistent with widespread diffusion of existing best practices, but not dependent on the uncertain creation of new technologies.

Table 5 shows normalized and high management yields for North Carolina for 1970, and the year in which the projected normalized yields of Table 3 equal the high management yields. For most crops, projected Basin yields do not approach those obtainable under today's best technology until late in the projection period. An exception is grain sorghum yields which are projected to surpass them in 1976, but this is a crop new to this area, grown in relatively small quantities by relatively few innovative producers who are likely to keep up with the latest technology.

THE SOIL RESOURCE BASE

While yields are an important measure of the productive capacity of the resource base, another measure is the amount of land available in each SPG. Column 1 of Table 6 presents the SPG acreages of the Chowan Basin based on the 1967 CNI. However, since the CNI is somewhat obsolete for wetland soil acreages, where forests are rapidly being converted to cropland, the 1990 acreages include estimates of newly cleared land.

Using a map overlay technique described in a separate publication (Ogg and Heimlich), the soil resource base was thus updated as described in Table 7, and net changes were included in Table 6, column 2. Table 8 indicates the amount of land in various uses that remains available to the LP model for clearing in the North Carolina soil groups where change

Table 5--Comparison of yield data, North Carolina, 1970

Crop	Normalized Yield[1/] (State Average)	High Management Yield[2/] (State Average)	Year in which best practice achieved[3/]
Corn - Grain	63 BU	96 BU	1996
Sorghum - Grain	53.4 BU	58 BU	1976
Wheat	39.5 BU	53 BU	1994
Soybeans	23.4 BU	37 BU	2010
Hay	1.5 TONS	2.8 TONS	2020+
Peanuts	2228 LBS	3008 LBS	1986
Tobacco	2176 LBS	2543 LBS	1984
Silage - Corn	13.3 TONS	25 TONS	2020+
- Sorghum	12.1 TONS	27 TONS	2020+

1/ Soil Productivity Groups of North Carolina, ERS/SCS April, 1975 (Parks, 1975)
2/ SCS Technical Guide Section IIB & RB-30 Committee, NC (USDA, SCS, 1973)
3/ Composite Yield Projections Based on 1947-1970 Yields (OBERS, 1974)

Table 6--Land resources available by SPG, Chowan Basin, 1990

SPG	Available cropland 1967 CNI[1/]	+	Acreage lost or cleared 1967-74[2/]	-	Acreage required for other crops[3/]	=	Available cropland
10	173,796		0		15,013		158,783
11	85,688		0		7,790		77,898
12	17,934		0		1,470		16,464
13	5,265		0		79		5,186
14	3,938		0		119		3,819
15	7,365		0		377		6,988
16	2,344		0		228		2,116
17	15,518		0		1,267		14,251
18	272,018		0		22,544		249,474
19	27,288		0		2,863		24,425
20	41,062		0		2,103		38,959
21	0		0		0		0
22	105,171		-4,056		10,360		90,755
23	313,894		776		16,037		298,633
24	4,118		0		395		3,723
25	59,928		17,056		3,601		73,383
26	209,533		43,436		12,973		239,996
27	162,369		39,146		6,134		195,381
28	7,972		0		2,061		5,911
29	26,860		0		571		26,289
30	14,276		0		1,245		13,031
31	1,262		10,918		0		12,180
Total	1,557,599		107,276		107,230		1,557,645

1/ 1967 Conservation Needs Inventory, all L land use codes.
2/ See Ogg and Heimlich (1977)
3/ Cotton, barley, oats, and other minor crops are not considered in the LP model.

Table 7--Soil productivity groups with land use changes, Coastal Plain[1/], Chowan Basin 1967-1974

SPG	1967 cropland & pasture	+	New cropland & pasture uses	-	New forest uses	=	1974 cropland & pasture	1967-1974 net change
22	22,628		0		4,056		18,572	-4,056
23	71,934		25,757		24,981		72,710	776
25	38,518		28,304		11,248		55,574	17,056
26	170,050		65,957		22,521		213,486	43,436
27	114,447		63,414		24,268		153,593	39,146
31	1,503		10,918		0		12,421	10,918
32	17,723		29,527		0		47,250	29,527
Total	436,803		223,877		87,074		573,606	136,803

1/ Bertie, Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell, and Washington counties.

Table 8--Forest Remaining, Southern Albemarle Sound[1/], 1967-74

SPG	ACRES			
	Evergreen Forest 42	Mixed Forest 43	Forested Wetland 61	Total
18	3,568.5			3,568.5
20			6,059.6	6,059.6
22	3,474.7		3,286.7	6,761.3
23		13,616.6	4,183.6	17,800.2
24			6,867.5	6,867.5
25			4,225.8	4,225.8
26	18,697.9	28,263.4	47,745.5	94,706.8
27	61,330.8	38,993.4	83,024.1	183,348.3
28			3,474.6	3,474.6
30			2,441.6	2,441.6
31	8,013.0	12,233.0	143,504.2	163,750.2
32	75,157.8	14,127.4	134,204.6	229,287.6
TOTAL 5 COUNTIES	170,242.7	107,233.8	439,017.8	722,292.0

1/ Bertie, Dare, Hyde, Tyrrell, and Washington counties

is occurring. (Since most of Virginia's soils in these categories are managed by the U.S. Fish and Wildlife Service, Virginia soils are not included in the available categories.)

DEVELOPMENT OF PRODUCTION COSTS

Crop yields, and also production costs, provide the basis for assigning production to SPG's. Costs of crop production for the LP model were derived from crop budgets developed by John Parks and M. Whiteside for North Carolina. Budgets were based on a July 1976 survey of farm production practices and were produced using the North Carolina State University budget generator.

Modifications were made to these budgets to resolve some inconsistencies between conventional and conservation tillage practices, and to reflect differences in agricultural practice between North Carolina and Virginia portions of the Basin. Price levels for fuels, fertilizers, and pesticides were updated to 1976-77. Costs for rotations were developed from the budgets for individual crops. Finally, additional cost items associated with potential land clearing and drainage, terracing, and contouring were calculated.

Costs of Basic Crops and Rotations

Crop budgets are constructed for each SPG and include preharvest costs, pesticide costs, fixed harvest costs, and fertilizer and harvest costs which vary with yield. Appendix C displays 1990 commodity costs in this level of detail by SPG for conventional and minimum tillage.

Inputs are priced at 1974-75 price levels, except for energy-related

inputs of fuels, fertilizers, and pesticides. These were valued at 1976-1977 prices to more fully reflect the greater relative importance of energy in agricultural production following the 1973 oil embargo.

Fertilizer prices were determined for elemental components of 33.5% N Ammonium Nitrate, 20% P_2O_5 Superphosphate and 60% K_2O Muriate of Potash mixes in North Carolina in 1976 (North Carolina Crop and Livestock Reporting Service, 1977). These were multiplied by the fertilizer amounts discussed below to obtain total fertilizer cost by SPG. Pesticide prices for 1977 for North Carolina were gathered by Extension personnel at North Carolina State University (Allgood, 1977). These prices were multiplied by the pesticide amounts discussed below to obtain total pesticide costs by crop and tillage method.

Costs of transporting harvested commodities off the field were the only component of harvest costs considered to vary according to yield. Variable harvest cost was adjusted by the ratio of SPG yield to budgeted yield. All other harvest costs were considered fixed.

The costs of crop rotations were calculated as weighted averages of the costs of individual crops in the rotation, with the proportion of time each crop was grown in the rotation as the weights. Thus the average annual cost of producing a two-year corn/soybean rotation equals one-half the cost of growing corn and one-half the cost of growing soybeans. One double crop system is included in the model, with wheat and soybeans produced in a single year on certain Coastal Plain soils.

Costs of Land Clearing

Large areas of wetland forests could be highly productive farmlands if it is economical to drain and clear them. Rapid clearing in recent

years suggests that it is economical (Ogg and Heimlich). OBERS projections used by this study are thus indicating further increases in crop acreage.

It is estimated that 150,302 acres of shallow muck in the North Carolina portion of the Basin are suitable for farm uses. This is in addition to the 12,421 acres that have already been cleared and are listed in SPG 31 in Table 7. Similarly, 827,421 acres of productive soils in SPG 26 and SPG 27 are available for clearing.

Table 9 indicates the clearing costs for muck soils and mineral soils. Amortised costs are added to the costs of farming on the respective soil productivity groups as they are listed in Appendix C. In the absence of any public intervention, potentially drainable areas, with their approximately fifty percent higher costs, will be competing with all the present SPG acreages listed in Table 6. (These clearing costs are intended to represent management practices of large private operators and are considerably lower than any estimates for public programs.)

To compensate for some of the drainage costs, there are, of course, higher yields on the lands which are being cleared. It is estimated that modern farming practices will achieve yields of 140 bushels per acre for corn and 40 bushels per acre for soybeans. These higher yields apply for typical operations because the soils are productive and high levels of management are being applied by the large operators who undertake the huge land clearing investments.

Costs of Terracing

The extent to which terracing is used as a conservation practice and the characteristics of terraces used in the Chowan Basin was

Table 9--Cost of clearing wetlands for farming in Eastern North Carolina

	total at end of year 1	accumulated at end of year 2 1/	life of investment in years	annual cost of future years at 6 3/8 %
Drainage costs: muck soil 2/	160	170	20	15.30
(mineral soil)	(53)	(56)	20	(5.00)
Clearing	367	390	perpetuity	24.90
Liming	68	72	"	4.60
Windrow	50	106	"	6.80
Wind breaks, etc.		100	"	6.40
Maintenance				6.50
Total investment				64.50
				(54.20)
Opportunity cost of forest stumpage 3/		200	30	+15.12

1/ Farming generally cannot begin until the third year, so cost plus interest is accumulated up to the beginning of the useful life of the project.

2/ This applies to local operators draining muck soils (SPG 31). The numbers in parenthesis are drainage costs on mineral soil (SPG 26 and 27).

3/ On productive mineral wetlands (SPG 26 and 27) it is estimated that stumpage value of 30 year old trees under no management is $200. The amortized value of $15.12 is included as an opportunity cost of giving up this potential income source.

investigated by tabulating State SCS 99 reports and interviewing Area and District Conservationists. Terraces are used to a limited extent in the western portion of the Basin on Piedmont soils of Virginia and Coastal Plain soils of North Carolina.

Costs of terracing include earth moving costs, construction costs, and the cost of grassed waterways. Costs are somewhat higher for the steeper Piedmont soils than for the Coastal Plain soils, as shown in Table 10. The total cost was amortized over a ten year period at 6-3/8 percent to derive annual costs for the structure which were then added to the cost of production for rotations occurring on terraced acreage.

Costs of Contouring

Additional costs for contour plowing result from increased machine and labor time since tillage operations cover a greater linear distance. For soils with slopes of less than five percent, ESCS estimates that tillage operations would cost five percent ($.90/acre of corn) more if done along contours. For soils with steeper slopes, tillage costs are increased ten percent. Increased tillage costs were added to the cost of production on all rotations involving contouring in SPG's 10 through 17.

DEVELOPMENT OF CHEMICAL USE

Special attention was given to applications of agricultural chemicals because of their importance in relation to yields and costs and their environmental impact. Local experts were consulted to reflect application practices and rates used in the Basin by good farm managers, as today's best management practices offer the best guide to average practices of the future.

Table 10--Cost of terraces, Chowan Basin

	Coastal Plain	Piedmont
	Costs per acre benefitted	
earthmoving	$150	$185
construction	60	75
grassed waterways	20	20
total cost	$230	$280
annual cost at 6-3/8% over 10 years	$31.81	$38.72

Projection of Fertilizer Use

Fertilizer application rates, shown in Appendix D, were derived from two sources. Application rates for phosphorus and potassium were provided by Parks (1976), whose figures were reviewed by soil scientists and resource conservationists at North Carolina State University. His estimates are appropriate for the Chowan study because yields for this river basin were based on Parks' 1970 yields by SPG developed for North Carolina and projected at basin-wide growth rates. Nitrogen applications were estimated based on efficiency factors for nitrogen in particular crops and nitrogen content of specific crops supplied by Professor J. W. Gilliam, Soil Scientist, North Carolina State University.

Projection of Pesticide Use

Pesticide regimes typical of better farmers in the study area were selected through interviews with extension agronomists E. G. Krenzer, Jr., J. Dunfy, R. E. Jarrett, A. Perry, W. Collins, and S. N. Hawks, of North Carolina State University, and extension entomology specialist J. E. Roberts, Sr., of the Virginia Polytechnic Institute, and through pesticide manuals (School of Agriculture and Life Sciences, Virginia Polytechnic Institute, 1977). Amounts of chemicals applied were adjusted to account for less than annual application frequency for control of certain pests. Special care was taken to distinguish between pesticide regimes under conventional and no-till or minimum tillage methods.

The wide variety of pesticides applied to crops makes it difficult to tell exactly how much "pesticides" are being applied or what the

impact of a particular pesticide regimen might be. An index of environmental exposure can reduce this complexity and combine the impacts of several pesticides into one measure. Indices were constructed using the amount applied, toxicity, persistance in the soil, and extent of ecological magnification, as shown in Appendix E. These indices were based on the work of Alt (1976) and Weber (August, 1977).

Projection of Energy Use

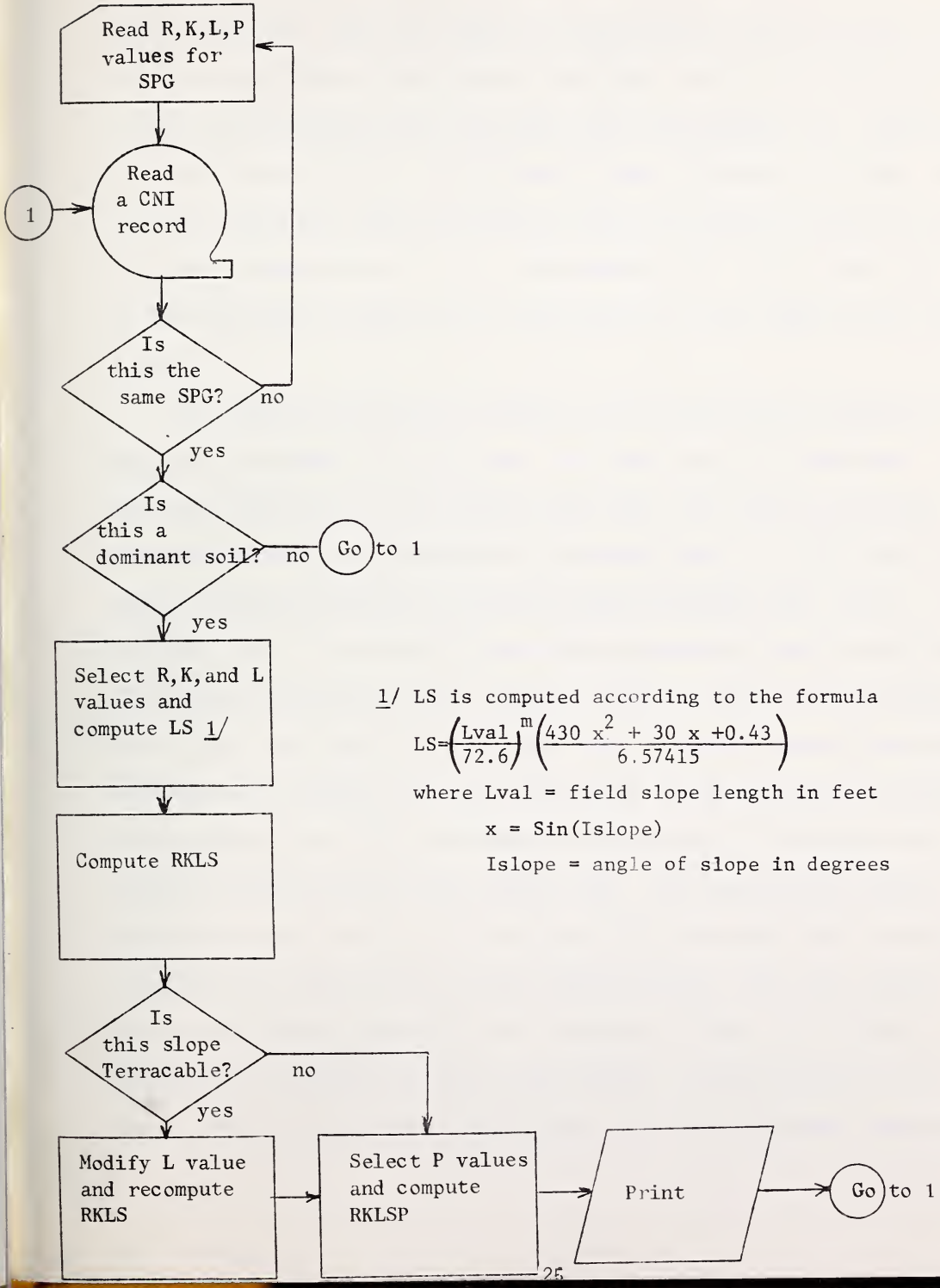
Energy embodied in the fuels, fertilizers, and pesticides was calculated using factors developed nationally (FEA/USDA, 1976) to convert to British Thermal Units (BTU's), as a common base. Amounts of fuel used in tillage, planting, spraying, and harvesting operations were derived from crop budgets and converted directly to BTU equivalents. Amounts of fertilizer projected above were multiplied by a conversion factor reflecting energy embodied in feed stocks, manufacture, and transportation. Pesticide amounts were similarly converted.

DEVELOPMENT OF SOIL LOSS ESTIMATES

Future soil loss per acre is calculated for the projected land uses using the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith and reported in "Predicting Rainfall-Erosion Losses from Cropland East of the Rocky Mountains" (Wischmeier and Smith, 1965). SCS personnel provided detailed local technical guides and much assistance, as did their Northeast Technical Service Center.

Soil loss is obtained by SPG, conservation practice, and cropping practice. The attached flow chart (Figure 2) describes the program used to calculate soil loss from data on the sample Conservation Needs

Figure 2--Soil loss computation flow chart



1/ LS is computed according to the formula

$$LS=\left(\frac{Lval}{72.6}\right)^{m}\left(\frac{430\ x^{2}+30\ x+0.43}{6.57415}\right)$$

where Lval = field slope length in feet

x = Sin(Islope)

Islope = angle of slope in degrees

Inventory (CNI) tape. For important soils in each SPG, the rainfall (R) and erodibility (K) factors are obtained and the slope effect (LS) factor computed. These are applied to conservation practice factors (P) for the slope class of the samples to estimate the soil loss which would occur on bare ground without any cover crop (See Appendix F). Cropping practice factors (C) for a wide range of crops, rotations, tillages, and residue regimes are then multiplied by this bare ground estimate to obtain the final estimate of soil loss. The computed soil loss is then aggregated to the SPG level in proportion to the acreage of each sample record (See Figure 2).

The important soils were selected by an examination of the area of each soil in an SPG. In each case, less than five soils comprised more than two-thirds of the acres in each SPG. All inputs to the USLE were determined from information on the sample tape or in SCS Technical Guides for North Carolina or Virginia (North Carolina, SCS, 1976; Virginia, SCS). The rainfall factor (R) was based on county boundaries. The erodibility factor (K) was listed for the top layer of each important soil. The slope factor (S) was taken from the sample tape and combined with the slope length factor (L), taken from survey information collected by SCS (USDA, SCS, 1972), according to the equation in Wischmeier and Smith to give the slope effect factor (LS). The conservation practice factors (P) and cropping practice factors (C) were taken from the North Carolina Soil Conservation Service Technical Guide, since this source had a more detailed description of rotations, tillages, and residue regimes than comparable Virginia publications. These are used in computing the soil loss on each SPG for the crops and management represented

in the linear programming model. (Each of these practices and the corresponding C factor is found in Table A-2.)

Soil Loss on Terraced Land

Terraces in the North Carolina portion of the Basin are primarily located in Northampton County. These are generally found on slopes of two to six percent and reduce slope lengths to between 72 and 96 feet. They do not require grassed fronts which would reduce tillable acreage. Terraces in the Virginia portion are of a non-standard design with narrower bases and lower storage capacity, but generally have the same characteristics as their North Carolina counterparts.

Soil loss computation for terraced acreage was limited to CNI records with slopes between two and six percent. The effect of terracing on gross soil erosion is felt in the topographic factor, LS, by reducing the slope length over which erosion occurs. Slope length was reduced to 96 feet on slopes of two to four percent and to 72 feet on slopes of four to six percent on terraced soil records. The resulting soil loss estimates for fallow ground are shown in Appendix F.

Although the study area is large, the procedure above makes maximum use of detailed soil and land use information in a way which is basically consistent with the assumptions underlying the USLE.[1/] By computing soil loss for a wide variety of cropping practices (150+) and conservation

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1/ Notice that coefficients were not averaged for each soil grouping, which would have multiplied errors (Wischmeier, 1976). Instead, soil erosion rates were calculated for highly detailed physical subclasses of each soil, and these erosion rates were then aggregated to our soil groups (which are defined according to soil management needs). This aggregation of erosion rates rather than soil loss coefficients avoids misuse of the Universal Soil Loss Equation.

practices (6 per slope class), sufficient variety is included in the linear program to evaluate the effects of production and management techniques.

PUTTING IT ALL TOGETHER

By way of summary, there are five major inputs to the planning model which include the following: (1) demand projections for Basin shares of national and world commodity markets in 1990 and 2020; (2) yield projections by SPG; (3) acreage available in each soil group; (4) costs of production, including costs of expanding the crop base of selected SPG's; and (5) soil loss estimates associated with a wide range of management and rotations, as these are applied to relevant SPG's. These data inputs represent a great deal of information that can be related to each other in a logical manner.

The soil groupings delineate areas with management needs, while their yields indicate the physical potential of each area in terms of meeting future output needs. When yields are combined with costs on each SPG, it becomes mathematically possible (under certain assumptions) to allocate land to its most efficient use. Finally, the soil loss estimates for each of the budgeted activities relate the immediate economic effects of resource use to certain effects on the environment. Such seemingly endless combinations of relationships are sorted out very comprehensibly in the linear programming model (LP).

Use of Linear Programming in River Basin Studies

The ultimate objective of the Chowan-Pasquotank Type IV River Basin Study is a set of plan components which will meet identified

needs related to enhancing environmental quality and encouraging economic development. In order to evaluate alternative plans, including the "without plan" alternative, a framework for consistently analyzing overall effects of each plan is necessary. An LP model of agricultural activity in the Basin can provide such a framework to simultaneously examine changes in cost of production, environmental effects, and use of land resources implied by establishment of any plan.

Agriculture is assumed to be a competitive industry in which producers take prices of inputs and outputs as given and try to maximize profit or, for given outputs, to minimize costs. Thus, after a suitable adjustment period, the pattern of agricultural production would be expected to approximate the minimum cost solution for meeting specified production levels with the available resources.

A particular plan for the Basin, by eliminating some land from production or requiring more costly crop management practices to retard erosion, would change the minimum cost solution. The change in costs between "with plan" and "without plan" runs, relative to the change in erosion, defines the trade-off between competing objectives for this particular plan.

Not all impacts which may be of interest can be incorporated in the LP because they are too complex to model with a single coefficient. Pollution from pesticides, for instance, depends on location relative to rivers and streams as well as other complex relationships of soil, rainfall, temperature, and application. Judgement must still be used when considering the resource use found to be "best" by linear programming, so as to allow for impacts not captured by the model. Appendix A indicates

more specifically the mathematical form and logic of a linear program.

Model Without Plan Results for 1990 and 2020

It is projected to cost Basin farmers $174.9 million to produce their OBERS output in 1990 under the assumption that no new plans or program changes are implemented. Cost for 2020 output levels are set at $307.8 million. Gross erosion in 1990 and 2020 from the same set of production activities reaches 12.7 million tons and 14.5 million tons, respectively.

Although several clearing activities were included in the model, only a portion of the muck soils in SPG 31 appear in the solution. This is not a strong indication that clearing will cease, but it means that OBERS output levels can generally be produced at lower cost from other sources.

Erosion rates vary among soil groups depending on the erosion characteristics of the soils and on how intensively farmers are expected to use the soil resource. Use intensity is based almost entirely on soil productivity for row crop production. Thus, total erosion and erosion rates projected for soil groups in these without plan projections are based upon the assumption that farmers are mainly motivated by maximizing short run profits without regard to damage to the long run productive capacity of their soil.[1/]

1/ This needs to be qualified to the extent that OBERS projections of hay crop production at the Basin level may be influenced by farmers' concern over the long term impacts of erosion, which would increase the historic allocation of land towards less erosive hay crops. However, several studies have indicated that, even in the long run, economic benefits of conservation measures to individual farmers are hard to document (White, 1978).

Low use intensity, non-erosive soils, such as SPG 15 in Table 11, are expected to have very low (0.7 tons/acre) average erosion from cropland, while an intensively used and erosive soil can lose as much as 53.7 tons per acre (Table 11). Several important soil groups fall in the 15-20 ton range. Figure 3 shows the approximate locations of cropland with projected rates of erosion.

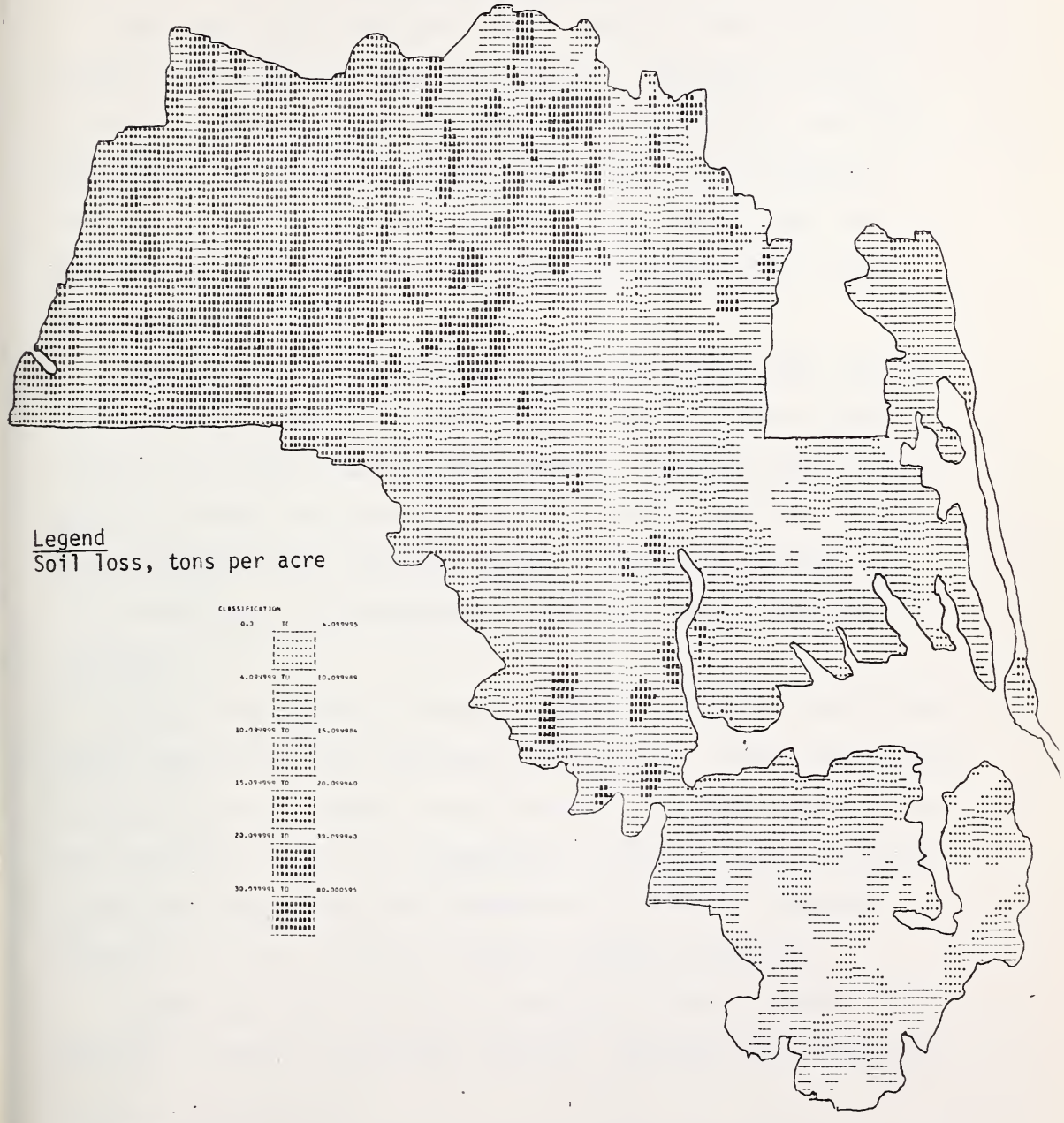
It is interesting that in Table 11 soil groups with the highest erosion hazards are to be used in ways that result in less erosion than soils that are only moderately erosive. This is because some of the highly erosive soils in the Basin (Class IV-VII) are generally not capable of substantial row crop yields. These erosive, less productive soil groups include SPG 12 and, especially, SPG 17 (Table 11). Erosion rates nearly as high as these are found on SPG 10, even though it contains much less erosive soils (Class IIe). Fortunately, such economic forces, which encourage hay production on steep areas, prevent the Basin's erosion from being more severe and make conservation initiatives less costly.

To include other relevant information, the without plan model solution has certain conservation activities that are currently used by many Basin farmers. Without attempting to explain the economic and other social reasons for using these practices, no-till activities in projection years were set at levels believed to be roughly consistent with trends established from SCS annual surveys. Thus, there are a total of 34,593 acres of no-till in Piedmont SPG's for the without plan solution. There are also 33,348 acres of contour farming. Distribution of these activities among soil groups is indicated in Table G-1.

Table 11--Erosion rates and crop outputs, by soil group

Types of Output	Soil Productivity Group																					
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Erosion (tons/acre)	15.9	21.0	8.2	0.9	5.8	0.7	57.5	19.1	11.1	15.5	41.0	0.0	8.6	8.6	0.8	5.7	6.1	5.5	3.9	0.0	18.7	0.3
Corn (1000 bu.)	1,127	1,006	72	115	9	32	39	12	5,033	224	801	0	1,357	6,032	0	745	4,368	2,371	46	0	75	4,382
Corn Silage (1000 tons)	0	104	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat (1000 bu.)	1,301	1,243	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soybeans (1000 bu.)	2,454	143	31	12	8	6	0	21	1,124	89	391	0	305	4,355	0	251	5,057	4,874	21	0	31	0
Sorghum (1000 bu.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tobacco (1000 lb.)	21,162	7,118	114	0	0	0	0	2,294	11,234	706	1,326	0	1,854	5,347	0	128	0	0	0	0	188	0
Peanuts (1000 lb.)	0	0	0	0	0	0	0	0	328,778	28,848	25,393	0	103,911	135,940	0	64,380	0	0	0	0	46,982	0
Hay (1000 tons)	0	0	18	5	4	8	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 3--Location of cropland with various erosion rates projected for 1990



Solution Comparisons

Some experts would argue that no-till farming is more attractive to Basin farmers than our model has indicated. Since use of no-till practices is on the increase, and since it is relatively new, there are considerable uncertainties in forecasting its use. It is therefore useful to explore the short run costs and erosion impacts under the alternative assumption that no-till farming on Piedmont soils is more widely adopted by 1990.[1/]

Comparing this solution (Table 12) with the "without plan" solution, it is evident that erosion is reduced considerably with only a moderate increase in the cost of meeting OBERS demands. Increased application of pesticides raises costs from $174.9 million to $175.4 million, in spite of lower machine costs. Erosion, however, is reduced 8.7 percent to 11.6 million tons. Crop distribution among SPG's remains relatively unchanged.

If long term benefits of erosion reduction in terms of reducing loss of soil productivity were considered, farmers might, in fact, move rapidly to no-till farming. However, no-till requires more sophisticated management techniques, as well as increased use of chemical inputs, so present trends would imply a need for planning and assistance if widespread adoption of no-till solutions to erosion problems is desired.

Another plan might call for increased use of chisel plowing. This approach is viewed as essentially costless. Switching from turnplow to

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1/ Here no-till is strictly defined to include essentially no plowing or disturbance of the soil surface.

Table 12--Costs, soil erosion, and conservation practices in 1990: solution comparisons under widely different assumptions

	Selected Without Plan Solution	No-till Solution	Chisel Plow Solution	Minimum Erosion Without Terrace Solution
Cost (in millions of dollars)	174.9	175.4	174.9	184.8
Gross Erosion (in millions of tons)	12.7	11.6	11.8	6.3
Terraced acres	0[1/]	0	0	0
No-till acres	34,592	146,393	34,592	584,248
Contour acres	10,511	39,003	33,347	12,471
Chisel plow acres	0	0	316,560	311,671
Strip cropped acres	0	0	0	37,797
No-till and terraced acres	0	0	0	2,622
No-till and strip cropped acres	0	0	0	12,107
Contour and strip cropped acres	0	0	0	10,399

1/ Zeros in this column are, of course, not strictly accurate; they indicate activities which are used at low enough levels as to not have significant impacts on Basin erosion totals.

chisel plowing in the Piedmont would reduce total Basin erosion by 7.1 percent with 11.8 million tons. Again, chisel plowing may be the wave of the future, or planning may be required to disseminate this practice.[1/]

Not all approaches to erosion reduction are as inexpensive. An extreme example is to allow the linear programming model to minimize erosion while ignoring cost. Terracing was the only conservation activity not considered in this solution which, otherwise, indicates the lowest possible erosion achievable, while meeting the OBERS outputs. Basin erosion is now only 6.3 million tons, but costs increase 5.7 percent. In Figure 4, inclusion of terracing would result in only 3.6 million tons at a cost of $194.9 million.

There is also considerable shifting of land uses under this extreme "plan." Table G-2 shows that more of SPG's 16 and 17 in the Piedmont and 25, 28, and 30 in the Coastal Plain were used, while less of SPG's 23 and 24 were used. More erosive crops such as corn and soybeans were grown in the Piedmont since these soils could be protected from erosion by conservation practices. Poorer soils in the Coastal Plain also gained acreage of corn and soybeans due to their lower erosion.

As shown in Table 12, more than four times the no-till cultivation was employed in this solution than in the no-till solution, but only one-third as much contour plowing. Almost as much chisel plowing was employed in the erosion solution as in the chisel plowing solution. In addition,

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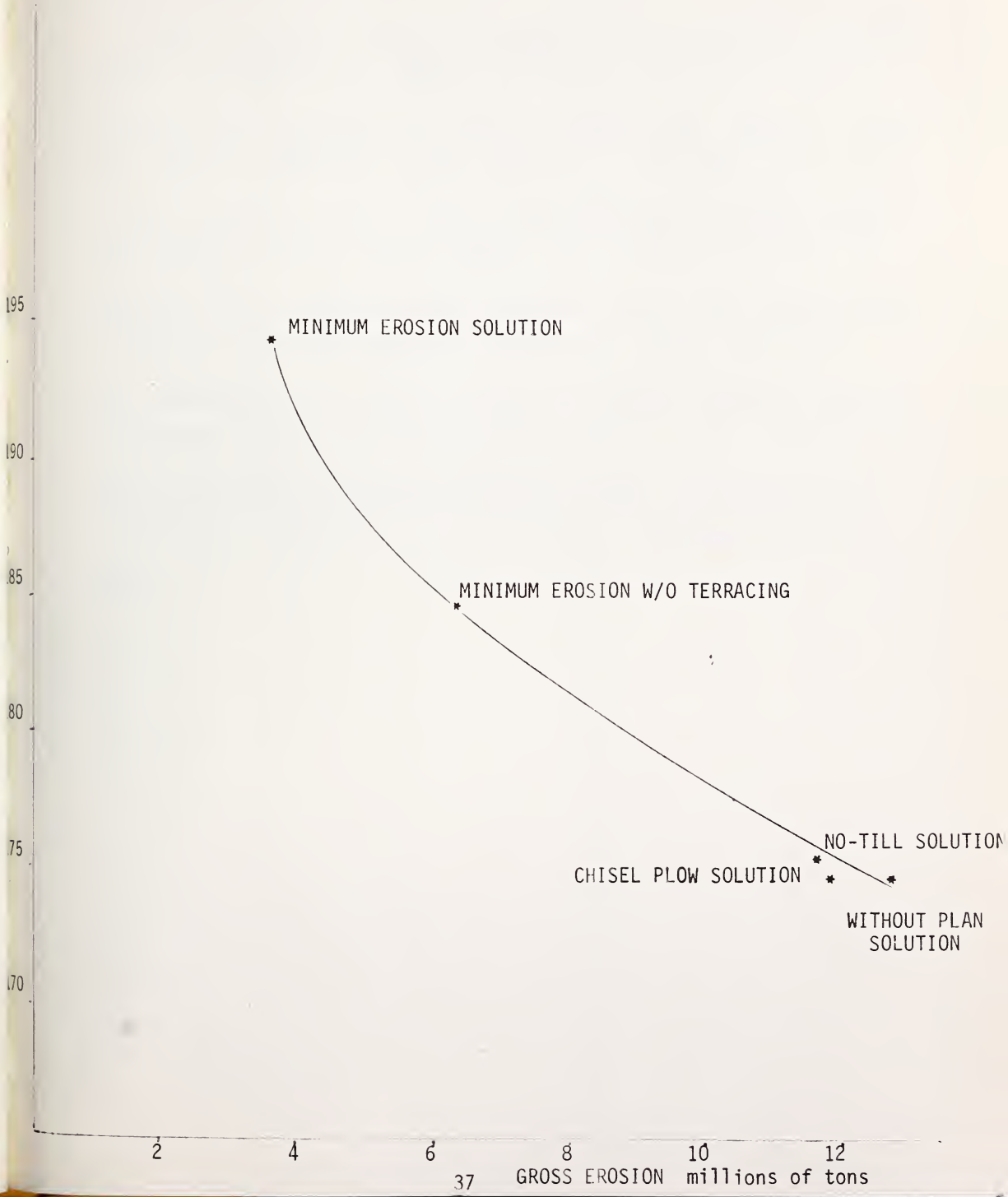
1/ Yield effects of both no-till and chisel plowing are the subject of ongoing study. Although no yield increases were included in this model, some have argued that dry weather yields on certain soils are measurably higher under reduced tillage systems. Yet these studies were conducted under skillful management and ignore risks for new practioners.

FIGURE 4 -- ALTERNATIVE LINEAR PROGRAM SOLUTIONS, CHOWAN MODEL 1990



approximately 50,000 acres of strip cropping and 10,000 acres of contour strip cropping were used in the erosion solution.

Restricting model solutions to emphasize certain practices, such as no-till, or exploring cost impacts of severe erosion restrictions are examples of how the model can be used to compare plans. However, several more realistic comparisons suggest themselves. For water quality plans, it might be more practical to apply restrictions only in certain watersheds which have water quality problems. Or, it may be useful to set basinwide erosion limits on a per acre basis and allow the planning model to select the most cost effective solutions for meeting these goals. Here the emphasis is on shifts in production between different locations in the Basin, and on selection of practices which are cost effective for meeting the conservation needs of each soil group. Alternatives such as these may be considered in the next phase of the Chowan-Pasquotank study.

APPENDIX A

WHAT IS A LINEAR PROGRAM?

WHAT IS A LINEAR PROGRAM?

Linear programming (LP) is an analytic method for discovering the optimal levels at which to operate numerous alternative activities which utilize the same scarce resources. The method is programming since each combination of activities running at specified levels constitutes a "program." It is linear since increasing the inputs to an activity by a given amount is assumed to produce an exactly proportional change in output. Linear programming considers all programs of the activities which use no more than the available resources and chooses the one program which produces the optimal objective value. Mathematically, this is equivalent to optimizing a linear objective function subject to a set of linear constraint equations representing the amount of inputs required for each activity and the amount of scarce resources available as inputs.

The Structure of the Linear Programming Model

The structure of the LP model constructed for the Chowan Basin can be looked at as either rows or columns, each of which offers a different perspective. The model is presented as a tableau in Figure A1. Table 1 shows the definition of each symbol used in Figure A1. An activity is defined by the combination of a land use (crop), grown on a specific soil productivity group, with a specific cropping practice. Thus, corn-growing on SPG 10 soils with conventional tillage practices is a different activity than corn-growing on SPG 10 soils with reduced tillage practices.

The rows of the tableau are of six kinds. Objective rows are either the cost per acre of using each activity or the profit per

acre accruing from each activity. Multiplied by the levels at which all activities are operated, the xj's, these rows equal the total cost, or the total profits, of the optimal program. Production constraint rows show the amount of each agricultural commodity produced by each activity. Multiplied by the activity levels, they are constrained to be greater than or equal to the production of each commodity demanded. Resource constraint rows show the amount of land in each SPG used in operating each activity at the unit level, equal to one acre for each activity in this model. The sum of these rows multiplied by the activity levels is constrained to be less than or equal to the amount of land in each SPG that is available for cropping. Crop Pattern constraint rows show the acreage in each SPG devoted to each crop and can be used to restrain the model solution from shifts in cropping patterns which would be extreme and unreasonable over the planning period. These constraints implicitly embody technological, institutional and temporal constraints on individual farmer's initiative which cannot be otherwise introduced explicitly. Environmental constraint rows show effects on the environment which result from operating each activity at the unit level, including gross soil erosion, amount of nutrients applied, pesticide exposure, and energy use. When multiplied by the activity levels, these rows equal the total gross soil erosion, nutrients applied, pesticide exposure and energy consumed under the optimal solution and can be used to limit environmental impacts of these elements to be less than specified levels. Technological constraint rows limit the amount of land in the Basin that can be farmed under minimum tillage systems and the amount that can be terraced. The

constraints can be specified so that either less than a given amount of land must use the technology or that at least as much as the given amount of land must employ the technology. Descriptions of model elements are presented in Table A-1.

Examining the tableau from the perspective of columns, each column represents a form of the linear production function of each activity. The inputs of fuel, fertilizer, seed, etc. are included in the cost figure, C_j, and result in a profit of π_j. Operation of the activity yields Y_{ij} of crop i, i=1,...; n and consumes 1.0 acres of land in a given SPG and $BTUF_j$, $FTUFT_j$ and $BTUP_j$ amounts of energy in the form of fuels, fertilizers and pesticides. The activity exposes the environment to E_j tons of gross soil erosion, N_j, P_j and K_j pounds of nitrogen, phosphorus and potassium fertilizer, and pesticides with an impact of A_j or W_j. If the activity uses minimum tillage or terracing, 1.0 appears in each of these positions. Descriptions of the activities in the model are presented in Table A-2.

In conclusion, the comparison of costs, profits, yields, resource use and environmental impact can be seen by concentrating on the rows of the tableau, while these same elements can be seen for each activity by looking down the columns. An example of part of the actual tableau solved in the computer is shown in Figure A-2.

Table A-1 -- Elements of the Chowan LP model

Variables

x_j	=	The level at which each activity j will be operated in the optimal program. This will be the number of acres on which activity j will be grown (j = 1, 2, . . ., n).

Coefficients

C_j	=	The cost per acre of carrying on activity j. These are the total costs per acre from the crop budgets described in Section 4.
π_j	=	The profit per acre which accrues from using activity j. This equals the normalized price of each unit times the yield per acre, minus the cost of production.
Y_{ij}	=	The output of product i produced by growing activity j on one acre. These are the projected yields described in Section 3.
N_j, P_j, K_j	=	The pounds of elemental nitrogen, phosphorus, and potassium fertilizer applied in operating activity j. These are described in Section 5.
E_j	=	The tons of gross soil erosion resulting from operation of activity j. This is discussed in Section 6.
A_j, W_j	=	The Alt and Weber indices of environmental exposure to pesticides resulting from activity j. These are described in Section 5.
$BTUF_j$, $BTUFT_j$, $BTUP_j$	=	The number of British Thermal Units (BTUs) embodied in the fuels, fertilizers, and pesticides applied in operating activity j. These are described in Section 5.

Right Hand Sides

Minimum Cost	=	The total cost of the optimal program.

Maximum Profit	=	The total profit derived from the optimal program.
Product Demands	=	The projected amounts of agricultural products which will be produced in the Basin. These are based on OBERS projections and discussed in Section 2.
Acres in SPGs	=	The acreage of each soil productivity group (SPG) available for production, discussed in Section 3.
Acres in Crop/SPG	=	The amount of acres devoted to specific crops in each SPG. This constraint is imposed to prevent drastic shifts in production patterns.
Environmental Constraints	=	The pounds of fertilizers, tons of soil, pesticide indices and BTUs used by the activities comprising the optimal program.
Technology Constraints	=	The total acres in minimum tillage farming or in terraces.

Figure A-1--Chowan Basin Linear programming model tableau.

ROWS \ COLUMNS	SPG-1, CORN-GROWING, CONVENTIONAL TILLAGE	SPG-1, CORN-GROWING, REDUCED TILLAGE	ONE COLUMN FOR EACH ACTIVITY (SOIL PRODUCTIVITY, LAND USE, CROPPING PRACTICE COMBINATION) CONSIDERED	SPG-33, CORN-SOYBEAN GROWING, REDUCED TILLAGE		RIGHT-HAND SIDE
OBJECTIVE ROWS						
Min. Cost	C_1x_1	C_2x_2	. . . . .	C_nx_n	=	Minimum Cost
Max. Profit	π_1x_1	π_2x_2	. . . . .	π_nx_n	=	Maximum Profit
PRODUCTION ROWS						
Corn	$Y_{11}x_1$	$Y_{12}x_2$	. . . . .	$Y_{1n}x_n$	≥	Corn demand
Soybeans	0	0	. . . . .	$Y_{2n}x_n$	≥	Soybean demand
:	:	:	. . . . .	:		:
etc	etc	etc	. . . . . etc	etc	≥	etc
LAND RESOURCE ROWS						
SPG 10	$1.0x_1$	$1.0x_2$	. . . . .	0	≤	Acres in SPG 10
SPG 11	0	0	. . . . .	0	≤	Acres in SPG 11
:	:	:	. . . . .	:		:
SPG 33	0	0	. . . . .	$1.0x_n$	≤	Acres in SPG 33
CROP PATTERN ROWS						
Corn/SPG 10	$1.0x_1$	0	. . . . .	0	≤ ≥	Acreage in Crop SPG 1

COLUMNS / ROWS	SPG-10 CORN-GROWING, CONVENTIONAL TILLAGE	SPG-10 CORN-GROWING, REDUCED TILLAGE	ONE COLUMN FOR EACH ACTIVITY (SOIL PRODUCTIVITY, LAND USE, CROPPING PRACTICE COMBINATION) CONSIDERED	SPG-33, CORN-SOYBEAN GROWING, REDUCED TILLAGE		RIGHT-HAND SIDE
Soybeans/SPG 10	0	$1.0x_2$	. . . . .	0	$\leq$ $\geq$	Acreage in Crop2 SPG 1
:	:	:	. . . . .	:		:
Corn/SPG 33	0	0	. . . . .	$1.0x_n$	$\leq$ $\geq$	Acreage in Crop1 SPG 3
Soybeans/SPG 33	0	0	. . . . .	$1.0x_n$	$\leq$ $\geq$	Acreage in Crop2 SPG 3
ENVIRONMENTAL ROWS						
Nitrogen	N_1x_1	N_2x_2	. . . . .	N_nx_n	$\leq$	Pounds of N
Phosphorus	P_1x_1	P_2x_2	. . . . .	P_nx_n	$\leq$	Pounds of P
Potassium	K_1x_1	K_2x_2	. . . . .	K_nx_n	$\leq$	Pounds of K
Erosion	E_1x_1	E_2x_2	. . . . .	E_nx_n	$\leq$	Tons of soil
Alt Index	Al_x^1	A_2x_2	. . . . .	A_nx_n	$\leq$	Total index
Weber Index	W_1x_1	W_2x_2	. . . . .	W_nx_n	$\leq$	Total index
BTU's in fuel	$BTUF_1x_1$	$BTUF_2x_2$	. . . . .	$BTUF_nx_n$	$\leq$	BTU's
BTU's in fertilizer	$BTUFT_1x_1$	$BTUFT_2x_2$	. . . . .	$BTUFT_nx_n$	$\leq$	BTU's
BTU's in pesticides	$BTUP_1x_1$	$BTUP_2x_2$	. . . . .	$BTUP_nx_n$	$\leq$	BTU's

COLUMNS / ROWS	SPG-1, CORN-GROWING, CONVENTIONAL TILLAGE	SPG-1, CORN-GROWING, REDUCED TILLAGE	ONE COLUMN FOR EACH ACTIVITY (SOIL PRODUCTIVITY, LAND USE, CROPPING PRACTICE COMBINATION) CONSIDERED	SPG-33, CORN-SOYBEAN GROWING, REDUCED TILLAGE		RIGHT-HAND SIDE
TECHNOLOGY ROWS						
Mintillage	0	1.0	. . . . .	1.0	≤	Acres of Minimum Tillage
Terracing	0	1.0	. . . . .	0	≤	Acres of Terracing

Table A-2 -- Crop practices in the Chowan LP

Abbreviations

VHP - very high productivity
HP - high productivity
MP - medium productivity
LP - low productivity

TP - turn plowed
cvt - conventional tillage
NT - no tillage
RDL - crop residue left on the field after harvest
RDR - crop residue removed during harvest
WC - winter cover crop
SG - small grains such as rye, oats, or barley
OS - overseeded in remaining crop residue

Line numbers refer to North Carolina Soil Conservation Service Technical Guide Section II-D, October, 1976.

CROP ROTATIONS BY MAJOR CROP
CHOWAN BASIN
PIEDMONT SPG 10-17

orn Grain

EARS	LINE NUMBER	ROTATION		C FACTOR
		One crop - continuous		
1	052	HP CORN GR TP, cvt, RDL	starts March	.313
	030	MP, LP CORN GR TP, cvt, RDL	starts April	.414
	119	HP CORN GR NT	starts May	.110
	201	MP, LP CORN GR NT	starts May	.259
		One crop - SG (WC)		
		No cvt - SG rotations		
1	086	MP CORN GR NT + SG disk and seed	starts May	.182
1	133	HP CORN GR NT + SG disk and seed	starts April	.082
		Two crop		
2	041	MP CORN GR TP, cvt, RDL + MP SOYBEANS TP, cvt, RDL starts April starts April		.356
2	043	HP CORN GR TP, cvt, RDL + HPTOB TP, cvt, RDL starts April starts April		.348
2	056	MP SOYBEANS TP, cvt, RDL + HP CORN GR NT RDL starts May starts April		.306
2	077	HP CORN GR TP, cvt, RDL + HP CORN NT RDL starts April starts April		.208
2	093	HP CORN GR NT, RDL + MP SOYBEANS NT, RDL starts April starts May		.175
		Two crop - SG (WC)		
2	073	MP CORN GR TP, cvt, RDL + SG - WC disk and seed RDL + Hay		.221
2	087	HP CORN GR TP, cvt, RDL + SG - WC, TP drill, + LP SOYBEANS NT, RDL		.182
2	098	HP CORN GR TP, cvt, RDL + SG - WC TP + MP SOYBEANS NT, RDL		.166
2	110	MP CORN GR NT, RDL + SG disk and plant, RDL + LP SOYBEANS NT, RDL		.129
2	130	HP CORN GR TP, cvt, RDL + SG - WC disk and seed + Hay (10 mos.)		.091
2	114	HP CORN GR NT, RDL + SG - WC disk and seed + HP SOYBEANS NT, RDL		.123
		Three crop		
3	032	MP CORN GR TP, cvt, RDL + HP Tob TP, cvt, RDL + MP SOYBEANS TP, cvt, RDL		.400
3	060	MP CORN GR TP, cvt, RDL + SG - WC disk and seed (18 mos.) and HP Tob TP, cvt, RDL		.290

EARS	LINE NUMBER	ROTATION		C FACTOR
3	137	MP CORN, TP, cvt + MP Wheat disk and seed RDL + Hay (18 mos.)		.071
3	152	VHP CORN GR TP, cvt + SG - WC disk and seed, RDL + Hay (20 mos.)		.039
3	157	HP CORN GR NT + SG - WC disk and seed RDL + Hay (21 mos.)		.027
3	038	HP Tob TP, + SG - WC disk and seed and MP Soybeans TP, cvt, RDL + MP CORN GR TP, cvt, RDL		.367
3	079	MP CORN GR NT, RDL + HP Tob TP, cvt, RDL + SG - WC disk and seed + MP Soybeans NT, RDL		.203
4	111	HP CORN GR TP, cvt, RDL + MP Soybeans TP, cvt + SG - WC disk and seed, RDL + Hay (17 mos.)		.128
4	149	HP CORN GR NT, RDL + HP CORN GR NT, RDL + SG-WC disk and seed and Hay (21 mos.)		.046
rn Silage				
		One crop - continuous		
1	016	MP CORNSIL TP, cvt, cut silage, RDR	starts March	.494
		One crop SG (WC)		
2	063	MP CORNSIL TP, cvt, cut silage, RDR + SG disk and seed, straw baled, RDR	start March	.270
		Two crop		
2	011	HP Tob TP, cvt, RDR + MP CORN SIL TP, RDR		.529
		start April start April		
ybeans				
		One crop - continuous		
1	020	MP SOYBEANS TP, cvt, RDL	start April	.463
1	018	LP SOYBEANS TP, cvt, RDL	start April	.471
1	068	MP SOYBEANS NT	start May	.250
		One crop-SG (WC)		
1	049	MP SOYBEANS Chisel plow, cvt, RDL + SG OS	start May	.315
1	028	LP SOYBEANS TP, cvt, RDL, + SG disk and seed	start April	.419
1	131	MP SOYBEANS NT + SG disk and seed	start June	.090
1	107	LP SOYBEANS NT + SG disk and seed	start June	.140
		Two Crop		
2	090	MP SOYBEANS TP, cvt + MP Wheat disk and plant RDL		.179
		start May start October		

EARS	LINE NUMBER	ROTATION		C FACTOR
		Two crop - SG (WC)		
2	050	CORN SIL TP, cvt + SG-WC disk and seed + LP SOYBEANS disk and plant RDL		.314
2	055	LP SOYBEANS TP, cvt, RDL + HP Tob TP, cvt, RDL + SG-WC disk and seed		.307
2	067	HP Tob TP, cvt and SG-WC disk and seed + MP Soybeans NT + SG-WC		.255
2	072	HP Tob TP, cvt, RDL + SG-WC disk and seed + LP Soybeans NT, RDL		.228
2	081	CORN SIL TP, cvt, RDR + SG-WC TP + LP Soybeans NT, RDL		.200
		Three crop		
3	088	HP Tob TP, cvt, RDL + HP Wheat disk and seed + MP Soybeans NT + MP Soybeans NT		.182
heat				
		One crop - continuous		
1	203	HP Wheat disk, RDL		.139
1	204	MP Wheat disk, RDL		.166
		One crop - SG (WC)		
		None		
rghum Grain				
1	025	HP Sorghum Grain TP, cvt, RDL	start April	.444
1	202	HP Sorghum Grain NT, RDL	start May	.195
		One crop SG (WC)		
1	045	HP Sorghum Grain Chisel plow, cvt, RDL + SG OS	start April	.339
1	125	MP Sorghum Grain NT + SG Chisel plow	start June	.094
		Two crop		
2	071	MP Sorghum Grain TP, DRL + SG disk and seed RDL start April start October		.232
bacco				
		One crop - continuous		
1	004	HP Tob, TP, No Rows Skipped, RDL	start Jan.	.560

EARS	LINE NUMBER	ROTATION	C FACTOR
		One crop - SG (WC)	
1	015	HP Tob, TP, RDL + SG (WC) disk and seed start March	.496
		Two crop	
2	065	HP Tob TP, cvt, RDL + SG disk and seed start April start October	.268
		Two crop - SG (WC)	
2	024	HP Tob TP, cvt, RDL + MP Corn Sil TP + SG - WC disk and seed	.449
2	035	HP Tob TP, cvt, RDL + SG=WC disk and seed + Sorghum Grain disk and plant, cvt, RDL	.371
2	069	HP Tob TP, cvt, RDL + SG - WC disk and seed + Sorghum Grain NT, RDL	.245
2	084	HP Tob TP, cvt, RDL + SG - WC disk and seed + Hay (8 mos.)	.185
ay			
		One crop - continuous	
1	205	Hay, fescue, TP, cvt	.021

ROTATIONS FOR CHISEL PLOWING
CHOWAN BASIN
PIEDMONT SPG 10-17

YEARS	LINE NUMBER	ROTATION	C FACTOR
Corn Grain			
1	206	HP CORN GR, chisel, RDL	.225
3	154	HP CORN, NT, RDL - SG (WC) chisel - HAY (21 mos.)	.036
4	149	HP CORN GR, NT, RDL - HP CORN GR, NT, RDL - SG (WC) chisel - HAY (21 mos.)	.046
Corn Silage			
4	113	VHP CORN SIL, TP, cvt, RDR - SG (WC) - HP CORN SIL, disk & plant, cvt, RDR - SG (WC) chisel, RDL - HAY (21 mos.)	.125
4	139	HP CORN SIL NT, RDR - SG (WC) - HP CORN SIL NT, RDR - SG (WC) chisel - HAY (21 mos.)	.071
Soybeans			
1	207	MP SOYBEANS, chisel, RDL	.225
2	090	MP SOYBEANS, chisel, cvt - MP WHEAT, disk & plant, RDL	.179
3	142	HP SOYBEANS, TP, cvt - SG (WC) chisel RDL - HAY (17 mos.)	.062
Sorghum			
3	076	HP SORGHUM TP, cvt, RDL - SG (WC) RDL - HAY - HP SOYBEANS chisel, cvt, RDL	.209

PIEDMONT

SPG 10-17

Productivity	ROTATION	SPGs	LINE	C VAL
HP	Corn Grain TP, cvt, RDL	10, 11, 13	052	.313
MP	Corn Grain TP, cvt, RDL	12, 15, 16	030	.414
LP	Corn Grain TP, cvt, RDL	14, 17	030	.414
HP	Corn Grain NT, RDL	10, 11, 13	119	.110
MP	Corn Grain NT, RDL	12, 14, 15, 16, 17	201	.259
MP	Corn Sil TP, cvt, cut silage, RDR	all	016	.494
HP	Wheat disk, RDL	10, 11, 12	203	.139
MP	Wheat disk, RDL	14, 16, 17	204	.166
MP	Soybeans TP, cvt, RDL	10, 11, 13	020	.463
LP	Soybeans TP, cvt, RDL	12, 14, 15, 17	018	.471
MP	Soybeans NT, OS	10, 11, 13	068	.250
LP	Soybeans NT, OS	12, 14, 15, 17	068	.250
HP	Sorghum Grain TP, cvt, RDL	all	025	.444
HP	Sorghum Grain NT, OS, RDL	all	138	.195
HP	F-C Tobacco TP, no rows skipped, RDL	all	004	.560
	Hay (fescue) TP, cvt	all	205	.021

CROP ROTATIONS BY MAJOR CROP
CHOWAN BASIN
COASTAL PLAIN SPG 18-33

Corn Grain

YEARS	LINE NUMBER	ROTATION	C FACTOR
		One crop - continuous	
1	501	VHP Corn Gr TP, cvt, RDL	.232
1	076	HP Corn Gr TP, cvt, RDL	.301
1	048	MP Corn Gr TP, cvt, RDL	.352
		One crop - SG (WC)	
		None	
		Two crop	
2	047	HP Corn Gr TP, cvt, RDL and LP Soybeans TP, cvt, RDL	.353
2	053	MP Corn Gr TP, cvt, RDL and MP Soybeans TP, cvt, RDL	.340
2	057	HP Corn Gr TP, cvt, RDL and HP Tob RDL	.332
2	061	HP Corn Gr TP, cvt, RDL and MP Soybeans TP, cvt, RDL	.322
2	118	HP Corn Gr TP, cvt, RDL and MP Soybeans NT, RDL	.181
		Two crop - SG (WC)	
2	042	HP Corn Gr TP, cvt, RDL and SG disk and plant and LP Soybeans disk and plant, cvt, RDL	.363
2	121	HP Corn Gr TP, cvt, RDL and SG disk and seed RDL, and MP Soybeans, NT, RDL	.169
2	150	VHP Corn Gr TP, cvt, RDL and SG disk and seed, RDL and Hay (8 mos.)	.085
		Three crop	
3	032	MP Corn Gr TP, cvt, RDL and 2 yrs. MP Soybeans TP, cvt, RDL	.400
3	035	HP Corn Gr TP, cvt, RDL and HP Tob, RDL and MP Soybeans TP, cvt, RDL	.383
2	109	HP Corn Gr TP, cvt, RDL and HP Tob, RDL and SG disk and seed, RDL	.213
		Three crop - SG (WC)	
3	062	HP Corn Gr TP, cvt, RDL and HP Tob, RDL and SG TP, disk and seed, RDL and MP Soybeans disk, cvt, RDL	.320
3	101	HP Corn Gr TP, cvt, RDL and SG disk and seed, RDL and Hay (9 mos.) and HP Soybeans NT, RDL	.232

YEARS	LINE NUMBER	ROTATION	C FACTOR
3	107	HP Corn Gr TP, cvt, RDL and HP Soybeans TP, cvt, RDL and SG disk and seed, RDL, and MP Soybeans NT, RDL	.220
		Four crop	
4	021	MP Corn Gr TP, cvt, RDL and HP Tob, RDL and LP Soybeans TP, cvt, RDL and HP Tob, RDL	.444
4	136	VHP Corn TP, RDL and HP Tob TP, RDL and SG disk and seed and Hay (20 mos.)	.131
Soybeans			
		One crop - continuous	
1	022	MP Soybeans disk and plant, cvt, RDL	.441
1	014	LP Soybeans disk, cvt, RDL	.502
1	502	MP Soybeans NT in 70% cover	.139
1	503	LP Soybeans NT in I.T. SG RDS	.225
		One crop - SG (WC)	
1	049	MP Soybeans disk, cvt, RDL and SG (WC) disk and seed	.348
1	151	MP Soybeans NT and SG (WC) disk and grazed seed	.082
1	142	LP Soybeans NT and SG disk and drill	.122
2	079	HP Tob TP, cvt, RDL and SG disk and seek RDL and MP Soybeans TP, disk and seed, RDL	.301
Tobacco			
		One crop - continuous	
1	009	HP Tob TP, disk and seed, RDL	.480
		One crop - SG (WC)	
1	015	HP Tob TP, disk and seed, RDL and SG (WC)	.451
		Two crop - SG (WC)	
2	029	HP Tob TP, RDL and MP Peanuts TP, RDL and SG (WC) disk and seed	.422
3	083	HP Tob TP, cvt, RDL and SG (WC) disk and seed and HP Tob TP, cvt, RDL and SG disk and seed and Hay (8 mos.)	.292
Corn Silage			
		One crop - continuous	
1	034	HP Corn Sil TP, cvt, RDR	.386
1	020	MP Corn Sil TP, cvt, RDR	.454

YEARS	LINE NUMBER	ROTATION	C FACTOR
		One crop - SG (WC)	
1	074	HP Corn Sil TP, cvt, RDR and SG (WC)	.302
Wheat			
		One crop - continuous	
1	504	MP Wheat, disk and seed	.135
Peanuts			
		One crop - continuous	
1	505	MP Peanuts, TP, cvt, RDL	.399
Hay			
		One crop - continuous	
1	506	Hay, fescue, disk and seed	.065

ROTATIONS FOR CHISEL PLOWING
CHOWAN BASIN
COASTAL PLAIN SPG 18-31

YEARS	LINE NUMBER	ROTATION	C FACTOR
CORN GRAIN			
1	135	HP CORN GR chisel, NT plant, RDL	.131
2	067	HP CORN GR TP, cvt, RDL - MP SOYBEANS disk, cvt, RDL	.317
3	063	HP CORN GR disk, cvt, RDL - MP CORN GR disk, cvt, RDL - PEANUTS chisel, cvt, RDR-SG (WC)	.320
3	081	VHP CORN GR chisel, cvt, RDL - HP CORN, chisel, cvt, RDL-HP PEANUTS, chisel, cvt, RDL	.295
2	132	VHP CORN GR chisel, cvt, RDL-SG(WC) RDL - SOYBEANS, NT, RDL	.136
4	148	VHP CORN TP, cvt, RDL - HP CORN, NT, RDL - Hay chisel (21 mos)	.090
CORN SIL			
3	133	HP CORN SIL NT, RDR-SG(WC) chisel - HP CORN SIL NT, RDR-SG(WC) chisel - Hay	.134
SOYBEANS			
1	160	HP SOYBEANS, NT - SG(WC) chisel	.032
TOBACCO			
3	096	MP TOBACCO TP, cvt, RDL-SG(WC) - MP CORN GR chisel, RDL-LP SOYBEANS chisel, RDL	.253

COASTAL PLAIN

SPG 18-33

Productivity	ROTATION	SPGs	LINE	C VAL
VHP	Corn Grain TP, cvt, RDL	18, 20, 23, 26, 27, 31	501	.232
HP	Corn Grain TP, cvt, RDL	19, 22	076	.301
MP	Corn Grain TP, cvt, RDL	21, 25	048	.352
LP	Corn Grain TP, cvt, RDL	28, 30	048	.352
HP	Corn Sil TP, cvt, 18 tons silage RDL	18, 23, 26	034	.386
MP	Corn Sil TP, cvt, 15 tons silage, RDR	20, 21, 22, 27	020	.454
LP	Corn Sil TP, cvt, 15 tons silage, RDR	19, 25	020	.454
MP	Wheat disk and seed	all	504	.135
MP	Soybeans disk, cvt, RDL	18-23, 26, 27	022	.441
LP	Soybeans disk, cvt, RDL	25, 28, 30	014	.502
MP	Soybeans NT in 70% cover, RDL	18-23, 26, 27	502	.139
LP	Soybeans NT in 1 T. cover, RDL	25, 28, 30	503	.225
	Hay fescue disk and seed	all	506	.065
MP	Peanuts TP, cvt, RDL	all	505	.399
HP	F-C Tobacco TP, disk and seed, RDL	all	009	.480

APPENDIX B

PROJECTED NORMALIZED YIELDS BY CROP AND SPG, 1970 - 2020

Table B-1--Corn for Grain: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	bu/acre						
1	65.9	90.2	96.8	103.0	113.7	122.7	130.4
2	54.7	74.9	80.4	85.5	94.4	101.9	108.3
3	50.1	68.6	73.6	78.3	86.4	93.2	99.1
4	65.9	90.2	96.8	103.0	113.7	122.7	130.4
5	43.5	59.6	64.0	68.1	75.2	81.1	86.2
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	62.6	85.7	92.0	97.9	108.1	116.6	123.9
11	56.7	77.6	83.3	88.6	97.8	105.5	112.1
12	43.5	59.6	64.0	68.1	75.2	81.1	86.2
13	62.6	85.7	92.0	97.9	108.1	116.6	123.9
14	36.2	49.6	53.2	56.6	62.5	67.4	71.6
15	39.5	54.1	58.0	61.7	68.1	73.5	78.1
16	42.8	58.6	62.9	66.9	73.9	79.7	84.7
17	32.9	45.0	48.3	51.4	56.7	61.2	65.1
18	72.5	99.3	106.5	113.3	125.1	135.0	143.5
19	49.4	67.6	72.5	77.1	85.1	91.8	97.6
20	74.4	101.9	109.3	116.3	128.4	138.5	147.2
21	42.8	58.6	62.9	66.9	73.9	79.7	84.7
22	52.7	72.1	77.4	82.4	91.0	98.2	104.4
23	79.1	108.3	116.2	123.6	136.5	147.3	156.6
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	42.8	58.6	62.9	66.9	73.9	79.7	84.7
26	69.2	94.7	101.6	108.1	119.3	128.7	137.9
27	72.5	99.3	106.5	113.3	125.1	135.0	143.5
28	36.2	49.6	53.2	56.6	62.5	67.4	71.6
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	32.9	45.0	48.3	51.4	56.7	61.2	65.1
31	59.3	81.2	87.1	92.7	102.3	110.4	117.4
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B-2--Corn Silage: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	ton/acre						
1	13.9	14.8	15.7	16.7	18.6	20.7	23.0
2	11.2	11.9	12.6	13.4	14.9	16.6	18.5
3	10.7	11.4	12.1	12.8	14.3	15.9	17.7
4	13.9	14.8	15.7	16.7	18.6	20.7	23.0
5	9.1	9.7	10.3	10.9	12.2	13.6	15.1
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	13.4	14.3	15.1	16.0	17.8	19.8	22.0
11	12.3	13.1	13.9	14.7	16.4	18.3	20.4
12	9.6	10.2	10.8	11.5	12.8	14.3	15.9
13	13.9	14.8	15.7	16.7	18.6	20.7	23.0
14	8.0	8.5	9.0	9.5	10.6	11.8	13.1
15	8.6	9.2	9.7	10.3	11.5	12.8	14.2
16	9.6	10.2	10.8	11.5	12.8	14.3	15.9
17	5.4	5.8	6.1	6.5	7.2	8.0	8.9
18	15.0	16.0	16.9	17.9	20.0	22.3	24.8
19	10.2	10.9	11.5	12.2	13.6	15.2	16.9
20	12.3	13.1	13.9	14.7	16.4	18.3	20.4
21	11.8	12.6	13.3	14.1	15.7	17.5	19.5
22	12.3	13.1	13.9	14.7	16.4	18.3	20.4
23	15.0	16.0	16.9	17.9	20.0	22.3	24.8
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	9.1	9.7	10.3	10.9	12.2	13.6	15.1
26	14.5	15.4	16.3	17.3	19.3	21.5	23.9
27	12.3	13.1	13.9	14.7	16.4	18.3	20.4
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B-3--Wheat: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	bu/acre						
1	44.4	44.5	47.7	50.8	56.0	60.5	64.3
2	34.7	34.8	37.3	39.7	43.7	47.2	50.1
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	44.4	44.5	47.7	50.8	56.0	60.5	64.3
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	44.4	44.5	47.7	50.8	56.0	60.5	64.3
11	40.7	40.8	43.8	46.6	51.4	55.5	58.9
12	37.0	37.1	39.8	42.3	46.6	50.3	53.4
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	33.3	33.4	35.8	38.1	42.0	45.4	48.2
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	29.6	29.7	31.9	33.9	37.4	40.4	42.9
17	18.5	18.5	19.9	21.2	23.4	25.3	26.9
18	44.4	44.5	47.7	50.8	56.0	60.5	64.3
19	33.3	33.4	35.8	38.1	42.0	45.4	48.2
20	44.4	44.5	47.7	50.8	56.0	60.5	64.3
21	33.3	33.4	35.8	38.1	42.0	45.4	48.2
22	37.0	37.1	39.8	42.3	46.6	50.3	53.4
23	44.4	44.5	47.7	50.8	56.0	60.5	64.3
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	40.7	40.8	43.8	46.6	51.4	55.5	58.9
27	40.7	40.8	43.8	46.6	51.4	55.5	58.9
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	25.9	26.0	27.9	29.7	32.7	35.3	37.5
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B-4--Soybeans: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	bu/acre						
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	22.3	27.0	28.3	29.4	31.5	33.2	34.7
11	19.1	23.2	24.3	25.2	27.0	28.4	29.7
12	15.9	19.3	20.2	21.0	22.5	23.7	24.8
13	22.3	27.0	28.3	29.4	31.5	33.2	34.7
14	14.0	17.0	17.8	18.5	19.8	20.9	21.8
15	15.9	19.3	20.2	21.0	22.5	23.7	24.8
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	12.7	15.4	16.2	16.8	18.0	19.0	19.9
18	28.0	34.0	35.7	37.1	39.8	42.0	43.9
19	19.1	23.2	24.3	25.2	27.0	28.4	29.7
20	25.5	30.9	32.4	33.7	36.1	38.0	39.7
21	19.1	23.2	24.3	25.2	27.0	28.4	29.7
22	19.1	23.2	24.3	25.2	27.0	28.4	29.7
23	28.0	34.0	35.7	37.1	39.8	42.0	43.9
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	15.9	19.3	20.2	21.0	22.5	23.7	24.8
26	26.7	32.4	34.0	35.3	37.8	39.8	41.7
27	28.7	34.8	36.5	37.9	40.6	42.8	44.8
28	12.7	15.4	16.2	16.8	18.0	19.0	19.9
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	12.7	15.4	16.2	16.8	18.0	19.0	19.9
31	15.9	19.3	20.2	21.0	22.5	23.7	24.8
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B-5--Sorghum for Grain: Projected normalized yields[1/]

SPG	1970	1980	1985	1990	2000	2010	2020
				bu/acre			
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	55.2	63.2	67.9	77.7	85.8	92.7	98.5
11	50.6	57.9	66.3	75.9	83.9	90.6	96.3
12	46.0	52.7	60.3	69.0	76.2	82.3	87.5
13	53.4	61.1	70.0	80.2	88.6	95.7	101.7
14	41.4	47.4	54.3	62.2	68.7	74.2	78.9
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	36.8	42.1	48.2	55.2	61.0	65.9	70.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	59.8	68.5	78.4	89.8	99.2	107.1	113.8
19	46.0	52.7	60.3	69.0	76.2	82.3	87.5
20	59.8	68.5	78.4	89.8	99.2	107.1	113.8
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	50.6	57.9	66.3	75.9	83.9	90.6	96.3
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1/ Computed from North Carolina yields only.

Table B-6--Tobacco: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	lbs/acre						
1*	2485.2	2910.2	3073.2	3223.8	3491.4	3718.3	3911.7
2*	2236.3	2618.7	2765.3	2900.8	3141.6	3345.8	3519.8
3*	1988.4	2328.4	2458.8	2579.3	2793.4	2975.0	3129.7
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1826.3	2138.6	2258.4	2369.1	2565.7	2732.5	2874.6
11	1775.5	2079.1	2195.5	2303.1	2494.3	2656.4	2794.5
12	1623.3	1900.9	2007.4	2105.8	2280.6	2428.8	2555.1
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1724.8	2019.7	2132.8	2237.3	2423.0	2580.5	2714.7
18	2384.3	2792.0	2948.4	3092.9	3349.6	3567.3	3752.8
19	1927.7	2257.3	2383.7	2500.5	2708.0	2884.0	3034.0
20	2130.6	2494.9	2634.6	2763.7	2993.1	3187.7	3353.5
21	1724.8	2019.7	2132.8	2237.3	2423.0	2580.5	2714.7
22	2017.0	2361.9	2494.2	2616.4	2833.6	3017.8	3174.7
23	2029.2	2376.2	2509.3	2632.3	2850.8	3036.1	3194.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1519.9	1779.8	1879.5	1971.6	2135.2	2274.0	2392.2
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1435.6	1682.3	1776.5	1863.5	2018.2	2149.4	2261.2
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*Burley tobacco; all rest flue tobacco.

Table B-7--Peanuts: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
	lbs/acre						
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	2593.5	2603.9	2767.9	2920.1	3188.7	3418.3	3609.7
19	2137.0	2145.5	2280.7	2406.1	2627.5	2816.7	2974.4
20	2080.0	2088.3	2219.9	2342.0	2557.5	2741.6	2895.1
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	2297.1	2306.3	2451.6	2586.4	2824.3	3027.6	3197.1
23	2000.7	2008.7	2135.2	2252.7	2459.9	2637.0	2784.7
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1778.4	1785.5	2135.2	2252.6	2459.8	2636.9	2784.6
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1482.0	1487.9	1581.6	1668.6	1822.1	1953.3	2062.7
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B-8--Hay: Projected normalized yields

SPG	1970	1980	1985	1990	2000	2010	2020
				-ton/acre-			
1	1.4	1.5	1.5	1.6	1.7	1.8	1.9
2	1.3	1.4	1.4	1.5	1.6	1.7	1.8
3	1.3	1.4	1.4	1.5	1.6	1.7	1.8
4	1.5	1.6	1.6	1.7	1.8	1.9	2.0
5	1.2	1.3	1.3	1.4	1.5	1.6	1.7
6	0.9	1.0	1.0	1.1	1.2	1.3	1.4
7	1.0	1.1	1.1	1.2	1.3	1.4	1.5
8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
9	0.4	0.4	0.4	0.4	0.4	0.4	0.4
10	1.7	1.8	1.8	1.9	2.0	2.1	2.2
11	1.4	1.5	1.5	1.6	1.7	1.8	1.9
12	1.6	1.7	1.7	1.8	1.9	2.0	2.1
13	2.1	2.2	2.2	2.3	2.4	2.5	2.6
14	1.7	1.8	1.8	1.9	2.0	2.1	2.2
15	1.5	1.6	1.6	1.7	1.8	1.9	2.0
16	1.0	1.1	1.1	1.2	1.3	1.4	1.5
17	1.0	1.1	1.1	1.2	1.3	1.4	1.5
18	2.3	2.4	2.4	2.5	2.6	2.7	2.8
19	2.0	2.1	2.1	2.2	2.3	2.4	2.5
20	2.1	2.2	2.2	2.3	2.4	2.5	2.6
21	1.3	1.4	1.4	1.5	1.6	1.7	1.8
22	2.0	2.1	2.1	2.2	2.3	2.4	2.5
23	2.0	2.1	2.1	2.2	2.3	2.4	2.5
24	1.5	1.6	1.6	1.7	1.8	1.9	2.0
25	1.3	1.4	1.4	1.5	1.6	1.7	1.8
26	1.7	1.8	1.8	1.9	2.0	2.1	2.2
27	1.9	2.0	2.0	2.1	2.2	2.3	2.4
28	1.3	1.4	1.4	1.5	1.6	1.7	1.8
29	1.0	1.1	1.1	1.2	1.3	1.4	1.5
30	1.2	1.3	1.3	1.4	1.5	1.6	1.7
31	1.2	1.3	1.3	1.4	1.5	1.6	1.7
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX C

PRODUCTION COSTS BY CROP AND SPG, 1990

Table C-1-- Corn for grain: Production costs, 1990

G	Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
					-dollars/acre-					
.	39.14	31.01	10.56	22.41	11.49	11.49	8.49	43.60	113.28	117.00
.	39.14	31.01	10.56	22.41	11.49	11.49	7.68	32.74	101.61	105.33
.	39.14	31.01	10.56	22.41	11.49	11.49	5.90	22.86	89.95	93.67
.	39.14	31.01	10.56	22.41	11.49	11.49	8.49	43.60	113.28	117.00
.	39.14	31.01	10.56	22.41	11.49	11.49	4.91	21.56	87.66	91.38
.	39.14	31.01	10.56	22.41	11.49	11.49	5.35	24.22	90.76	94.48
.	39.14	31.01	10.56	22.41	11.49	11.49	5.80	26.77	93.76	97.48
.	39.14	31.01	10.56	22.41	11.49	11.49	4.46	15.95	81.60	85.32
.	35.57	0.00	17.36	0.00	11.38	0.00	10.31	51.04	125.66	0.00
.	35.57	0.00	17.36	0.00	11.38	0.00	7.02	32.72	104.05	0.00
.	35.57	0.00	17.36	0.00	11.38	0.00	10.58	54.69	129.58	0.00
.	35.57	0.00	17.36	0.00	11.38	0.00	6.09	28.77	99.17	0.00
.	35.57	0.00	17.36	0.00	11.38	0.00	7.50	34.94	106.75	0.00
.	35.57	0.00	17.36	0.00	11.38	0.00	11.25	56.17	131.73	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	6.09	27.85	98.25	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	9.84	48.85	123.00	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	10.31	54.38	129.00	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	5.15	22.75	92.21	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	4.68	20.67	89.66	0.00
	35.57	0.00	17.36	0.00	11.38	0.00	8.43	39.30	112.04	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-2--Corn silage: Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no ti
-dollars/acre-									
32.39	21.40	10.56	22.41	21.03	21.03	28.12	54.40	146.50	147.5
32.39	21.40	10.56	22.41	21.03	21.03	25.84	43.54	133.36	134.2
32.39	21.40	10.56	22.41	21.03	21.03	20.21	33.66	117.85	118.7
32.39	21.40	10.56	22.41	21.03	21.03	29.35	54.40	147.73	148.5
32.39	21.40	10.56	22.41	21.03	21.03	16.70	32.36	113.04	113.9
32.39	21.40	10.56	22.41	21.03	21.03	18.10	35.02	117.10	117.9
32.39	21.40	10.56	22.41	21.03	21.03	20.21	37.57	121.76	122.6
32.39	21.40	10.56	22.41	21.03	21.03	11.42	26.75	102.15	103.0
25.57	0.00	17.36	0.00	21.04	0.00	33.72	61.84	159.53	0.0
25.57	0.00	17.36	0.00	21.04	0.00	22.98	43.52	130.47	0.0
25.57	0.00	17.36	0.00	21.04	0.00	27.70	65.49	157.16	0.0
25.57	0.00	17.36	0.00	21.04	0.00	26.56	39.57	130.10	0.0
25.57	0.00	17.36	0.00	21.04	0.00	27.70	45.74	137.41	0.0
25.57	0.00	17.36	0.00	21.04	0.00	33.72	66.97	164.66	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
25.57	0.00	17.36	0.00	21.04	0.00	20.54	38.65	123.16	0.0
25.57	0.00	17.36	0.00	21.04	0.00	32.59	59.65	156.21	0.0
25.57	0.00	17.36	0.00	21.04	0.00	27.70	65.18	156.85	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Table C-3--Wheat: Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no till
-dollars/acre-									
29.71	27.23	0.00	3.63	9.75	9.75	8.80	45.38	93.64	94.79
29.71	27.23	0.00	3.63	9.75	9.75	8.08	43.00	90.54	91.69
29.71	27.23	0.00	3.63	9.75	9.75	7.33	40.41	87.20	88.35
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.71	27.23	0.00	3.63	9.75	9.75	6.60	36.83	82.89	84.04
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.71	27.23	0.00	3.63	9.75	9.75	5.87	28.94	74.27	75.42
29.71	27.23	0.00	3.63	9.75	9.75	3.67	25.91	69.04	70.19
33.74	0.00	3.63	0.00	9.75	0.00	8.80	42.98	98.90	0.00
33.74	0.00	3.63	0.00	9.75	0.00	6.60	35.63	89.35	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.80	42.98	98.90	0.00
33.74	0.00	3.63	0.00	9.75	0.00	6.60	35.63	89.35	0.00
33.74	0.00	3.63	0.00	9.75	0.00	7.33	38.01	92.46	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.80	42.98	98.90	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.08	40.60	95.80	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.08	40.60	95.80	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.74	0.00	3.63	0.00	9.75	0.00	5.15	30.66	82.93	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-4--Soybeans: Production costs, 1990

	Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
					-dollars/acre-					
).	26.32	18.09	15.73	28.08	9.75	9.75	7.28	12.12	71.20	75.3
.	26.32	18.09	15.73	28.08	9.75	9.75	6.24	10.48	68.52	72.6
).	26.32	18.09	15.73	28.08	9.75	9.75	5.20	6.32	63.32	67.4
).	26.32	18.09	15.73	28.08	9.75	9.75	7.28	12.12	71.20	75.3
).	26.32	18.09	15.73	28.08	9.75	9.75	4.58	5.40	61.78	65.9
).	26.32	18.09	15.73	28.08	9.75	9.75	5.20	6.66	63.66	67.7
).	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
).	26.32	18.09	15.73	28.08	9.75	9.75	4.16	3.50	59.46	63.5
).	28.30	19.89	16.89	29.21	9.75	9.75	9.19	17.60	81.73	85.6
).	28.30	19.89	16.89	29.21	9.75	9.75	6.24	6.80	67.98	71.8
).	28.30	19.89	16.89	29.21	9.75	9.75	8.34	12.92	76.20	80.1
).	28.30	19.89	16.89	29.21	9.75	9.75	6.24	12.40	73.58	77.4
).	28.30	19.89	16.89	29.21	9.75	9.75	6.24	6.80	67.98	71.8
).	28.30	19.89	16.89	29.21	9.75	9.75	9.19	15.56	79.69	83.6
).	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
).	28.30	19.89	16.89	29.21	9.75	9.75	5.20	3.44	63.58	67.4
).	28.30	19.89	16.89	29.21	9.75	9.75	8.74	14.58	78.26	82.1
).	28.30	19.89	16.89	29.21	9.75	9.75	9.38	20.00	84.32	88.2
).	28.30	19.89	16.89	29.21	9.75	9.75	4.16	1.12	60.22	64.1
).	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
).	28.30	19.89	16.89	29.21	9.75	9.75	4.16	7.28	66.38	70.2
).	28.30	19.89	16.89	29.21	9.75	9.75	9.90	3.44	68.28	72.1
).	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
).	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Table C-5--Sorghum: Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no till
-dollars/acre-									
28.25	17.47	15.68	20.63	8.27	8.27	16.83	30.26	99.29	93.46
28.25	17.47	15.68	20.63	8.27	8.27	16.44	30.79	99.43	93.60
28.25	17.47	15.68	20.63	8.27	8.27	14.95	28.14	95.29	89.46
28.25	17.47	15.68	20.63	8.27	8.27	17.37	30.56	100.13	94.30
28.25	17.47	15.68	20.63	8.27	8.27	13.47	23.09	88.76	82.93
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28.25	17.47	15.68	20.63	8.27	8.27	11.96	19.45	83.61	77.78
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-6--Tobacco: Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
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Table C-7-- Peanuts : Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
-dollars/acre-									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	40.30	28.20	277.35	0.00
110.05	0.00	70.36	0.00	28.44	0.00	33.20	7.58	249.63	0.00
110.05	0.00	70.36	0.00	28.44	0.00	32.32	4.40	245.57	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	35.69	2.64	247.18	0.00
110.05	0.00	70.36	0.00	28.44	0.00	31.09	0.00	239.94	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	31.09	19.80	259.74	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	23.03	0.00	231.88	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-8--Hay: Production costs, 1990

G	Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
					-dollars/acre-					
.	10.32	0.00	0.00	0.00	11.68	0.00	13.60	27.85	63.45	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	11.45	22.62	56.07	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	12.88	26.10	60.98	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	16.46	33.72	72.18	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	13.60	27.85	63.45	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	12.16	24.80	58.96	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	8.59	16.74	47.33	0.00
.	10.32	0.00	0.00	0.00	11.68	0.00	8.59	16.74	47.33	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	17.89	35.21	81.45	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	15.74	30.86	74.95	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	16.46	33.72	78.53	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	10.73	20.53	59.61	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	15.74	30.86	74.95	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	15.74	32.22	76.31	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	12.16	23.68	64.19	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	10.73	21.41	60.49	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	13.59	27.85	69.79	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	15.03	30.46	73.84	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	10.73	21.41	60.49	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	8.59	15.96	52.90	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	10.02	19.33	57.70	0.00
.	16.67	0.00	0.00	0.00	11.68	0.00	10.02	28.03	66.40	0.00
.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-9-- Wheat & Soybeans: Production costs, 1990

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Tota Cos (no t
-dollars/acre-									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	34.86	60.58	189.96	187.05
62.41	47.18	20.52	32.84	11.59	11.59	23.68	42.43	160.63	157.72
62.41	47.18	20.52	32.84	11.59	11.59	31.66	55.90	182.08	179.17
62.41	47.18	20.52	32.84	11.59	11.59	23.68	48.03	166.23	163.32
62.41	47.18	20.52	32.84	11.59	11.59	23.68	44.81	163.01	160.10
62.41	47.18	20.52	32.84	11.59	11.59	34.86	58.54	187.92	185.01
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	19.73	3.44	117.69	114.78
62.41	47.18	20.52	32.84	11.59	11.59	33.16	55.18	182.86	179.95
62.41	47.18	20.52	32.84	11.59	11.59	35.61	60.60	190.73	187.82
62.41	47.18	20.52	32.84	11.59	11.59	15.78	1.12	111.42	108.51
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	15.78	7.28	117.58	114.67
62.41	47.18	20.52	32.84	11.59	11.59	19.73	34.10	148.35	145.44
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-10--Corn for Grain: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
39.14	31.01	10.56	22.41	11.49	11.49	10.74	52.51	124.44	128.16
39.14	31.01	10.56	22.41	11.49	11.49	9.72	49.31	120.22	123.94
39.14	31.01	10.56	22.41	11.49	11.49	7.47	32.20	100.86	104.58
39.14	31.01	10.56	22.41	11.49	11.49	10.74	52.51	124.44	128.16
39.14	31.01	10.56	22.41	11.49	11.49	6.21	29.87	97.27	100.99
39.14	31.01	10.56	22.41	11.49	11.49	6.77	33.74	101.70	105.42
39.14	31.01	10.56	22.41	11.49	11.49	7.34	37.26	105.79	109.51
39.14	31.01	10.56	22.41	11.49	11.49	5.64	21.76	88.59	92.31
35.57	0.00	17.36	0.00	11.38	0.00	13.06	59.25	136.62	0.00
35.57	0.00	17.36	0.00	11.38	0.00	8.88	42.76	115.95	0.00
35.57	0.00	17.36	0.00	11.38	0.00	13.40	62.90	140.61	0.00
35.57	0.00	17.36	0.00	11.38	0.00	7.71	40.32	112.34	0.00
35.57	0.00	17.36	0.00	11.38	0.00	9.50	46.21	120.02	0.00
35.57	0.00	17.36	0.00	11.38	0.00	14.25	67.53	146.09	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.57	0.00	17.36	0.00	11.38	0.00	7.71	36.10	108.12	0.00
35.57	0.00	17.36	0.00	11.38	0.00	12.55	56.84	133.70	0.00
35.57	0.00	17.36	0.00	11.38	0.00	13.06	62.59	139.96	0.00
35.57	0.00	17.36	0.00	11.38	0.00	6.52	30.33	101.16	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.57	0.00	17.36	0.00	11.38	0.00	5.92	28.34	98.57	0.00
35.57	0.00	17.36	0.00	11.38	0.00	10.68	53.50	128.49	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-11--Corn Silage: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
32.39	21.40	10.56	22.41	21.03	21.03	38.67	63.31	165.96	166.82
32.39	21.40	10.56	22.41	21.03	21.03	35.85	60.11	159.94	160.80
32.39	21.40	10.56	22.41	21.03	21.03	27.94	43.00	134.92	135.78
32.39	21.40	10.56	22.41	21.03	21.03	40.42	63.31	167.71	168.57
32.39	21.40	10.56	22.41	21.03	21.03	23.02	40.67	127.67	128.53
32.39	21.40	10.56	22.41	21.03	21.03	24.96	44.54	133.48	134.34
32.39	21.40	10.56	22.41	21.03	21.03	27.94	48.06	139.98	140.84
32.39	21.40	10.56	22.41	21.03	21.03	15.64	32.56	112.18	113.04
25.57	0.00	17.36	0.00	21.04	0.00	46.72	70.05	180.74	0.00
25.57	0.00	17.36	0.00	21.04	0.00	31.84	53.56	149.37	0.00
25.57	0.00	17.36	0.00	21.04	0.00	28.43	73.70	166.10	0.00
25.57	0.00	17.36	0.00	21.04	0.00	36.74	51.12	151.83	0.00
25.57	0.00	17.36	0.00	21.04	0.00	38.43	57.01	159.41	0.00
25.57	0.00	17.36	0.00	21.04	0.00	46.72	78.33	189.02	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.57	0.00	17.36	0.00	21.04	0.00	28.45	46.90	139.32	0.00
25.57	0.00	17.36	0.00	21.04	0.00	45.03	67.64	176.64	0.00
25.57	0.00	17.36	0.00	21.04	0.00	38.43	73.39	175.79	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-12--Wheat: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no till
29.71	27.23	0.00	3.63	9.75	9.75	11.14	53.15	103.75	104.90
29.71	27.23	0.00	3.63	9.75	9.75	10.21	50.13	99.80	100.95
29.71	27.23	0.00	3.63	9.75	9.75	9.25	46.89	95.60	96.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.71	27.23	0.00	3.63	9.75	9.75	8.35	43.86	91.67	92.82
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.71	27.23	0.00	3.63	9.75	9.75	7.43	40.84	87.73	88.88
29.71	27.23	0.00	3.63	9.75	9.75	4.66	24.11	68.23	69.38
33.74	0.00	3.63	0.00	9.75	0.00	11.14	50.75	109.01	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.35	41.46	96.93	0.00
33.74	0.00	3.63	0.00	9.75	0.00	11.14	50.75	109.01	0.00
33.74	0.00	3.63	0.00	9.75	0.00	8.35	41.46	96.93	0.00
33.74	0.00	3.63	0.00	9.75	0.00	9.25	44.49	100.86	0.00
33.74	0.00	3.63	0.00	9.75	0.00	11.14	50.75	109.01	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.74	0.00	3.63	0.00	9.75	0.00	10.21	47.73	105.06	0.00
33.74	0.00	3.63	0.00	9.75	0.00	10.21	47.73	105.06	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.74	0.00	3.63	0.00	9.75	0.00	6.50	35.20	88.82	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-13--Soybeans: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
26.32	18.09	15.73	28.08	9.75	9.75	8.59	16.46	76.85	80.97
26.32	18.09	15.73	28.08	9.75	9.75	7.35	24.64	83.79	87.9
26.32	18.09	15.73	28.08	9.75	9.75	6.14	9.32	67.26	71.3
26.32	18.09	15.73	28.08	9.75	9.75	8.59	16.46	76.85	80.97
26.32	18.09	15.73	28.08	9.75	9.75	5.40	7.24	64.44	68.56
26.32	18.09	15.73	28.08	9.75	9.75	6.14	9.32	67.26	71.3
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
26.32	18.09	15.73	28.08	9.75	9.75	4.93	5.64	62.37	66.4
28.30	19.89	16.89	29.21	9.75	9.75	10.87	17.60	83.41	87.3
28.30	19.89	16.89	29.21	9.75	9.75	7.35	9.92	72.21	76.1
28.30	19.89	16.89	29.21	9.75	9.75	9.83	20.00	84.77	88.6
28.30	19.89	16.89	29.21	9.75	9.75	7.35	17.10	79.39	83.3
28.30	19.89	16.89	29.21	9.75	9.75	7.35	14.72	77.01	80.9
28.30	19.89	16.89	29.21	9.75	9.75	10.87	20.00	85.81	89.7
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
28.30	19.89	16.89	29.21	9.75	9.75	6.14	5.96	67.04	70.9
28.30	19.89	16.89	29.21	9.75	9.75	10.32	20.00	85.26	89.1
28.30	19.89	16.89	29.21	9.75	9.75	11.09	20.00	86.03	89.9
28.30	19.89	16.89	29.21	9.75	9.75	4.93	2.76	62.63	66.5
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
28.30	19.89	16.89	29.21	9.75	9.75	4.93	8.80	68.67	72.5
28.30	19.89	16.89	29.21	9.75	9.75	11.27	5.96	72.17	76.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Table C-14--Sorghum: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
28.25	17.47	15.68	20.63	8.27	8.27	21.34	37.26	110.80	104.97
28.25	17.47	15.68	20.63	8.27	8.27	20.86	37.66	110.72	104.89
28.25	17.47	15.68	20.63	8.27	8.27	18.95	34.37	105.52	99.69
28.25	17.47	15.68	20.63	8.27	8.27	22.03	37.54	111.77	105.94
28.25	17.47	15.68	20.63	8.27	8.27	17.09	29.11	98.40	92.57
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28.25	17.47	15.68	20.63	8.27	8.27	15.16	25.04	92.40	86.57
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-15--Tobacco: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
554.05	0.00	106.48	0.00	375.11	0.00	17.54	60.74	1,113.92	0.00
554.05	0.00	106.48	0.00	375.11	0.00	17.05	59.88	1,112.57	0.00
554.05	0.00	106.48	0.00	375.11	0.00	15.59	57.50	1,108.73	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
554.05	0.00	106.48	0.00	375.11	0.00	16.56	59.23	1,111.43	0.00
554.05	0.00	106.48	0.00	375.11	0.00	22.89	69.60	1,128.13	0.00
554.05	0.00	106.48	0.00	375.11	0.00	18.51	62.47	1,116.62	0.00
554.05	0.00	106.48	0.00	375.11	0.00	20.46	65.71	1,121.81	0.00
554.05	0.00	106.48	0.00	375.11	0.00	16.56	59.23	1,111.43	0.00
554.05	0.00	106.48	0.00	375.11	0.00	19.37	63.77	1,118.78	0.00
554.05	0.00	106.48	0.00	375.11	0.00	19.48	63.98	1,119.10	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
554.05	0.00	106.48	0.00	375.11	0.00	14.59	55.99	1,106.22	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
554.05	0.00	106.48	0.00	375.11	0.00	13.79	54.70	1,104.13	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-16--Peanuts: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	49.81	28.20	286.86	0.00
110.05	0.00	70.36	0.00	28.44	0.00	41.05	7.58	257.48	0.00
110.05	0.00	70.36	0.00	28.44	0.00	39.95	4.40	253.20	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	44.12	2.64	255.61	0.00
110.05	0.00	70.36	0.00	28.44	0.00	38.43	0.00	247.28	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	38.43	19.80	267.08	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110.05	0.00	70.36	0.00	28.44	0.00	28.47	0.00	237.32	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-17--Hay: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
10.32	0.00	0.00	0.00	11.68	0.00	15.74	32.42	70.16	0.00
10.32	0.00	0.00	0.00	11.68	0.00	13.59	27.41	63.00	0.00
10.32	0.00	0.00	0.00	11.68	0.00	15.03	30.46	67.49	0.00
10.32	0.00	0.00	0.00	11.68	0.00	18.60	39.39	79.99	0.00
10.32	0.00	0.00	0.00	11.68	0.00	15.74	32.42	70.16	0.00
10.32	0.00	0.00	0.00	11.68	0.00	14.31	29.15	65.46	0.00
10.32	0.00	0.00	0.00	11.68	0.00	10.73	21.31	54.04	0.00
10.32	0.00	0.00	0.00	11.68	0.00	10.73	21.31	54.04	0.00
16.67	0.00	0.00	0.00	11.68	0.00	20.03	40.20	88.58	0.00
16.67	0.00	0.00	0.00	11.68	0.00	17.89	35.75	81.99	0.00
16.67	0.00	0.00	0.00	11.68	0.00	18.60	39.73	86.68	0.00
16.67	0.00	0.00	0.00	11.68	0.00	12.88	24.78	66.01	0.00
16.67	0.00	0.00	0.00	11.68	0.00	17.89	35.75	81.99	0.00
16.67	0.00	0.00	0.00	11.68	0.00	17.89	37.89	84.13	0.00
16.67	0.00	0.00	0.00	11.68	0.00	14.31	27.79	70.45	0.00
16.67	0.00	0.00	0.00	11.68	0.00	12.88	25.76	66.99	0.00
16.67	0.00	0.00	0.00	11.68	0.00	15.74	32.86	76.95	0.00
16.67	0.00	0.00	0.00	11.68	0.00	17.17	36.10	81.62	0.00
16.67	0.00	0.00	0.00	11.68	0.00	12.88	25.76	66.99	0.00
16.67	0.00	0.00	0.00	11.68	0.00	10.73	19.99	59.07	0.00
16.67	0.00	0.00	0.00	11.68	0.00	12.16	23.24	63.75	0.00
16.67	0.00	0.00	0.00	11.68	0.00	12.16	33.80	74.31	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table C-18--Wheat & Soybeans: Production costs, 2020

Pre-Harv. Cost (conv)	Pre-Harv. Cost (no till)	Pesticide Cost (conv)	Pesticide Cost (no till)	Fixed Harv. Cost (conv)	Fixed Harv. Cost (no till)	Var. Harv. Cost	Fertilizer Cost	Total Cost (conv)	Total Cost (no til
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	41.24	68.35	204.11	201.20
62.41	47.18	20.52	32.84	11.59	11.59	27.90	51.38	173.80	170.89
62.41	47.18	20.52	32.84	11.59	11.59	37.30	70.75	202.57	199.66
62.41	47.18	20.52	32.84	11.59	11.59	27.90	58.56	180.98	178.07
62.41	47.18	20.52	32.84	11.59	11.59	27.90	59.21	181.63	178.72
62.41	47.18	20.52	32.84	11.59	11.59	41.24	70.75	206.51	203.60
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	23.30	5.96	123.78	120.87
62.41	47.18	20.52	32.84	11.59	11.59	39.18	67.73	201.43	198.52
62.41	47.18	20.52	32.84	11.59	11.59	42.09	67.73	204.34	201.43
62.41	47.18	20.52	32.84	11.59	11.59	18.70	2.76	115.98	113.07
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62.41	47.18	20.52	32.84	11.59	11.59	18.70	8.80	122.02	119.11
62.41	47.18	20.52	32.84	11.59	11.59	23.30	41.16	158.98	156.07
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX D

FERTILIZER APPLICATION BY CROP AND SPG, 1990 AND 2020

Table D-1 -- Corn for grain: Fertilizer application, 1990 and 2020

Nitrogen		Phosphorous		Potassium		1990 Total Cost	2020 Total Cost
1990	2020	1990	2020	1990	2020		
- - - - - - - - - - pounds - - - - - - - - - -						- - dollars - -	
120.	152.	52.	52.	52.	72.	43.60	52.51
109.	138.	25.	50.	32.	75.	32.74	49.31
84.	106.	13.	25.	16.	33.	22.86	32.20
120.	152.	52.	52.	52.	72.	43.60	52.51
70.	88.	21.	34.	14.	27.	21.56	29.87
76.	96.	25.	40.	18.	34.	24.22	33.74
82.	104.	29.	45.	21.	40.	26.77	37.26
63.	80.	6.	12.	9.	16.	15.95	21.76
139.	177.	53.	53.	83.	83.	51.04	59.25
95.	120.	35.	46.	38.	58.	32.72	42.76
143.	181.	55.	55.	106.	106.	54.69	62.90
82.	104.	29.	44.	41.	73.	28.77	40.32
101.	128.	38.	49.	40.	68.	34.94	46.21
152.	193.	66.	66.	75.	100.	56.17	67.53
0.	0.	0.	0.	0.	0.	0.00	0.00
82.	104.	31.	36.	27.	50.	27.85	36.10
133.	170.	48.	48.	86.	86.	48.85	56.84
139.	177.	59.	59.	102.	102.	54.38	62.59
67.	88.	27.	33.	18.	34.	22.75	30.33
0.	0.	0.	0.	0.	0.	0.00	0.00
63.	80.	19.	29.	25.	41.	20.67	28.34
114.	144.	37.	60.	58.	80.	39.30	53.50
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-2 -- Corn silage: Fertilizer application, 1990 and 2020

SPG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	pounds						dollars	
10	170.	202.	52.	52.	52.	72.	54.40	63.31
11	159.	188.	25.	50.	32.	75.	43.54	60.11
12	134.	156.	13.	25.	16.	33.	33.66	43.00
13	170.	202.	52.	52.	52.	72.	54.40	63.31
14	120.	138.	21.	34.	14.	27.	32.36	40.67
15	126.	146.	25.	40.	18.	34.	35.02	44.54
16	132.	154.	29.	45.	21.	40.	37.57	48.06
17	113.	130.	6.	12.	9.	16.	26.75	32.56
18	189.	227.	53.	53.	83.	83.	61.84	70.05
19	145.	170.	35.	46.	38.	58.	43.52	53.56
20	193.	231.	55.	55.	106.	106.	65.49	73.70
21	132.	154.	29.	44.	41.	73.	39.57	51.12
22	151.	178.	38.	49.	40.	68.	45.74	57.01
23	202.	243.	66.	66.	75.	100.	66.97	78.33
24	0.	0.	0.	0.	0.	0.	0.00	0.00
25	132.	154.	31.	36.	27.	50.	38.65	46.90
26	183.	220.	48.	48.	86.	86.	59.65	67.64
27	189.	227.	59.	59.	102.	102.	65.18	73.39
28	120.	138.	27.	33.	18.	34.	34.20	41.13
29	0.	0.	0.	0.	0.	0.	0.00	0.00
30	0.	0.	0.	0.	0.	0.	0.00	0.00
31	164.	194.	37.	60.	58.	80.	50.10	64.30
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-3 -- Wheat: Fertilizer application, 1990 and 2020

SPG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	- - - - - - - - - - - - pounds - - - - - - - - - - - -						- - dollars - -	
10	136.	172.	50.	50.	40.	40.	45.38	53.15
11	125.	158.	50.	50.	40.	40.	43.00	50.13
12	113.	143.	50.	50.	40.	40.	40.41	46.89
13	0.	0.	0.	0.	0.	0.	0.00	0.00
14	102.	129.	45.	50.	40.	40.	36.83	43.86
15	0.	0.	38.	0.	0.	0.	9.12	0.00
16	91.	115.	22.	50.	40.	40.	28.94	40.84
17	57.	72.	40.	19.	40.	40.	25.91	24.11
18	136.	172.	40.	40.	40.	40.	42.98	50.75
19	102.	129.	40.	40.	40.	40.	35.63	41.46
20	136.	172.	40.	40.	40.	40.	42.98	50.75
21	102.	129.	40.	40.	40.	40.	35.63	41.46
22	113.	143.	40.	40.	40.	40.	38.01	44.49
23	136.	172.	40.	40.	40.	40.	42.98	50.75
24	0.	0.	0.	0.	0.	0.	0.00	0.00
25	0.	0.	0.	0.	0.	0.	0.00	0.00
26	125.	158.	40.	40.	40.	40.	40.60	47.73
27	125.	158.	40.	40.	40.	40.	40.60	47.73
28	0.	0.	0.	0.	0.	0.	0.00	0.00
29	0.	0.	0.	0.	0.	0.	0.00	0.00
30	0.	0.	0.	0.	0.	0.	0.00	0.00
31	79.	100.	40.	40.	40.	40.	30.66	35.20
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-4 -- Soybeans: Fertilizer application, 1990 and 2020

SPG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	pounds						dollars	
10	0.	0.	38.	54.	30.	35.	12.12	16.46
11	0.	0.	32.	86.	28.	40.	10.48	24.64
12	0.	0.	18.	28.	20.	26.	6.32	9.32
13	0.	0.	38.	54.	30.	35.	12.12	16.46
14	0.	0.	15.	21.	18.	22.	5.40	7.24
15	0.	0.	19.	28.	21.	26.	6.66	9.32
16	0.	0.	0.	0.	0.	0.	0.00	0.00
17	0.	0.	10.	16.	11.	18.	3.50	5.64
18	0.	0.	40.	40.	80.	80.	17.60	17.60
19	0.	0.	20.	28.	20.	32.	6.80	9.92
20	0.	0.	38.	50.	38.	80.	12.92	20.00
21	0.	0.	30.	40.	52.	75.	12.40	17.10
22	0.	0.	20.	28.	20.	80.	6.80	14.72
23	0.	0.	44.	50.	50.	80.	15.56	20.00
24	0.	0.	0.	0.	0.	0.	0.00	0.00
25	0.	0.	11.	19.	8.	14.	3.44	5.96
26	0.	0.	42.	50.	45.	80.	14.58	20.00
27	0.	0.	50.	50.	80.	80.	20.00	20.00
28	0.	0.	3.	9.	4.	6.	1.12	2.76
29	0.	0.	0.	0.	0.	0.	0.00	0.00
30	0.	0.	22.	25.	20.	28.	7.28	8.80
31	0.	0.	11.	19.	8.	14.	3.44	5.96
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-5 -- Sorghum: Fertilizer application, 1990 and 2020

SPG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	pounds						dollars	
10	96.	121.	28.	33.	28.	32.	30.26	37.26
11	93.	119.	35.	39.	23.	26.	30.79	37.66
12	85.	108.	32.	36.	21.	24.	28.14	34.37
13	99.	125.	27.	31.	27.	31.	30.56	37.54
14	77.	97.	19.	24.	19.	24.	23.09	29.11
15	0.	0.	0.	0.	0.	0.	0.00	0.00
16	68.	86.	14.	19.	14.	19.	19.45	25.04
17	0.	0.	0.	0.	0.	0.	0.00	0.00
18	111.	140.	25.	29.	33.	38.	33.28	41.00
19	85.	108.	23.	24.	27.	30.	26.58	32.09
20	111.	140.	22.	23.	29.	38.	32.16	39.56
21	0.	0.	0.	0.	0.	0.	0.00	0.00
22	93.	119.	23.	25.	29.	32.	28.51	34.90
23	0.	0.	0.	0.	0.	0.	0.00	0.00
24	0.	0.	0.	0.	0.	0.	0.00	0.00
25	0.	0.	0.	0.	0.	0.	0.00	0.00
26	0.	0.	0.	0.	0.	0.	0.00	0.00
27	0.	0.	0.	0.	0.	0.	0.00	0.00
28	0.	0.	0.	0.	0.	0.	0.00	0.00
29	0.	0.	0.	0.	0.	0.	0.00	0.00
30	0.	0.	0.	0.	0.	0.	0.00	0.00
31	0.	0.	0.	0.	0.	0.	0.00	0.00
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-6 -- Tobacco: Fertilizer application, 1990 and 2020

PG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	pounds						dollars	
0	111.	134.	70.	70.	150.	150.	55.78	60.74
1	107.	130.	70.	70.	150.	150.	54.91	59.88
2	98.	119.	70.	70.	150.	150.	52.97	57.50
3	0.	0.	0.	0.	0.	0.	0.00	0.00
4	0.	0.	0.	0.	0.	0.	0.00	0.00
5	0.	0.	0.	0.	0.	0.	0.00	0.00
6	0.	0.	0.	0.	0.	0.	0.00	0.00
7	104.	127.	70.	70.	150.	150.	54.26	59.23
8	144.	175.	70.	70.	150.	150.	62.90	69.60
9	117.	142.	70.	70.	150.	150.	57.07	62.47
10	129.	157.	70.	70.	150.	150.	59.66	65.71
11	104.	127.	70.	70.	150.	150.	54.26	59.23
12	122.	148.	70.	70.	150.	150.	58.15	63.77
13	123.	149.	70.	70.	150.	150.	58.37	63.98
14	0.	0.	0.	0.	0.	0.	0.00	0.00
15	92.	112.	70.	70.	150.	150.	51.67	55.99
16	0.	0.	0.	0.	0.	0.	0.00	0.00
17	0.	0.	0.	0.	0.	0.	0.00	0.00
18	0.	0.	0.	0.	0.	0.	0.00	0.00
19	0.	0.	0.	0.	0.	0.	0.00	0.00
30	87.	106.	70.	70.	150.	150.	50.59	54.70
31	0.	0.	0.	0.	0.	0.	0.00	0.00
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-7 -- Peanuts: Fertilizer application, 1990 and 2020

Nitrogen		Phosphorous		Potassium		1990 Total Cost	2020 Total Cost
1990	2020	1990	2020	1990	2020		
- - - - - - - - - - - - pounds - - - - - - - - - - - -						- - dollars - -	
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	80.	80.	90.	90.	28.20	28.20
0.	0.	17.	17.	35.	35.	7.58	7.58
0.	0.	10.	10.	20.	20.	4.40	4.40
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	6.	6.	12.	12.	2.64	2.64
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	45.	45.	90.	90.	19.80	19.80
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00
0.	0.	0.	0.	0.	0.	0.00	0.00

Table D-8 -- Hay: Fertilizer application, 1990 and 2020

SPG	Nitrogen 1990	Nitrogen 2020	Phosphorous 1990	Phosphorous 2020	Potassium 1990	Potassium 2020	1990 Total Cost	2020 Total Cost
	pounds						dollars	
10	78.	91.	25.	29.	50.	58.	27.85	32.42
11	66.	78.	19.	24.	38.	48.	22.62	27.41
12	74.	86.	23.	27.	46.	54.	26.10	30.46
13	95.	107.	30.	37.	60.	74.	33.72	39.39
14	78.	91.	25.	29.	50.	58.	27.85	32.42
15	70.	82.	22.	26.	44.	52.	24.80	29.15
16	49.	62.	14.	18.	28.	36.	16.74	21.31
17	49.	62.	14.	18.	28.	36.	16.74	21.31
18	103.	115.	29.	34.	60.	72.	35.21	40.20
19	91.	103.	25.	30.	52.	63.	30.86	35.75
20	95.	107.	30.	38.	60.	75.	33.72	39.73
21	62.	74.	16.	20.	33.	40.	20.53	24.78
22	91.	103.	25.	30.	52.	63.	30.86	35.75
23	91.	103.	29.	36.	56.	70.	32.22	37.89
24	70.	82.	19.	22.	40.	48.	23.68	27.79
25	62.	74.	18.	22.	37.	45.	21.41	25.76
26	78.	91.	25.	30.	50.	60.	27.85	32.86
27	86.	99.	27.	33.	54.	68.	30.46	36.10
28	62.	74.	18.	22.	37.	45.	21.41	25.76
29	49.	62.	12.	15.	25.	30.	15.96	19.99
30	58.	70.	15.	18.	32.	38.	19.33	23.24
31	58.	70.	35.	42.	71.	86.	28.03	33.80
32	0.	0.	0.	0.	0.	0.	0.00	0.00
33	0.	0.	0.	0.	0.	0.	0.00	0.00

APPENDIX E

PESTICIDE APPLICATION BY CROP, 1990

Crop and Material	Toxicity LD50 1/ mg/kg	Toxicity LC50 2/ mg/l	Persistance In Soil, Yrs. 3/	Ecological Magnification 4/	Active Ingredient Per Acre, Lbs. 5/	Formulation Amount Unit/AC	Formulation Price $/Unit 6/	Cost of Application $/Ac.
CORN GRAIN & CORN SILAGE								
Insecticide								
FURADAN 10G (carabofuran)	8	0.21	0.115 a/	0	1.0	10.0 lb	.69	6.90
Herbicide								
Pre-emergence								
Conv. Till-Coastal Plain								
AATREX 4L (atrazine)	3080	12.60	1.096	11	1.2	1.2 qt	4.04	4.84
LASSO 4 (alachlor)	1200	2.30	.150	0	1.5	1.5 qt	3.75	5.62
Conv. Till-Piedmont								
AATREX 4L (atrazine)	3080	12.60	1.096	11	1.2	1.2 qt	4.04	4.84
PRINCEP 80wp (simazine)	5000	5.00	1.096	192 c/	1.5	1.75 lb	3.27	5.72
No till-Piedmont								
In rotation w/ small grain								
Add Ortho Paraquat CL 2 lb/gal (paraquat)	150	400.0	1.370	0 c/	.5	2.0 pt	4.95	9.90
In rotation w/ peanuts or soybeans								
Add 2-4D AMINE 4 lb/ gal	370	15.00	.084	0	.5	1.0 pt	1.20	1.20
In rotation w/ tobacco								
Substitute LASSO for PRINCEP								

Table E-1--Pesticide Application, 1990

Crop and Material	Toxicity LD_{50}[1/] mg/kg	Toxicity LC_{50}[2/] mg/l	Persistance In Soil, Yrs.[3/]	Ecological Magnification[4/]	Active Ingredient Per Acre, Lbs.[5/]	Formulation Amount Unit/AC	Formulation Price $/Unit[6/]	Cost of Application $/Ac.
Pre-emergence no-till								
High-Management Only								
EVIK 80wp	1110	2.00	.164	5[c/]	1.2	1.5 lb	3.25	5.02
SOYBEANS								
Insecticide								
SEVIN 80s (carbaryl)	500	1.00	.011	0	0.5	.67 lb	1.73	1.16
Herbicide								
Pre-Plant								
TREFLAN EC (trifluralin)	3700	.58[d/]	.411	4200	0.8	1.5 pt	3.74	5.61
Pre-Emergence-Conv. Till								
LASSO 4 lbs/gal (alachlor)	1200	2.30	.150	0	2.7	2.7 qt	3.75	10.12
DYNAP								
(dinoseb,	5	.40	.063	19[c/]	1.0			
naptalam)	1770	180.0	.110	5[c/]	2.0	4.0 qt	1.68	6.73
Pre-Emergence No Till								
Add Ortho Paraquat CL (paraquat)	150	400.0	1.370	0[c/]	.5	2.0 pt	4.95	9.90
Replace Dynap with								
LOROX (linuron)	1500	16.00	.329	13[c/]	2.0	2.0 lb	3.70	7.40
SORGHUM GRAIN								
Herbicide								
Pre-Emergence Conv. Till								
RAMROD-ATRAZINE								
(atrazine,	3080	12.60	1.096	11	1.6			
propachlor)	710	1.30	.110	0	3.9	3.0 lb	1.96	15.68

Table E-1--Pesticide Application, 1990

Crop and Material	Toxicity		Persistance	Ecological	Active	Formulation		Cost of Application
	LD_{50}[1/] mg/kg	LC_{50}[2/] mg/l	In Soil, Yrs.[3/]	Magnification[4/]	Ingredient Per Acre, Lbs.[5/]	Amount Unit/AC	Price $/Unit[6/]	$/Ac.
Pre-Emergence No Till								
ADD ORTHO PARAQUAT CL	150	400.0	1.370	0[c/]	.5	2.0 pt	4.95	9.90

Table E-1--Pesticide Application, 1990

Crop and Material	Toxicity: LD_{50}[1/] mg/kg	Toxicity: LC_{50}[2/] mg/l	Persistance In Soil, Yrs.[3/]	Ecological Magnification[4/]	Active Ingredient Per Acre, Lbs.[5/]	Formulation Amount Unit/AC	Formulation Price $/Unit[6/]	Cost of Application $/Ac.
WHEAT								
Herbicide								
BANVEL K	1028	35	0.192 b/	0	0.13			
(diacmba, 2, 4-D)	370	15	.084	0	0.25	0.8 pt	4.54	3.63
PEANUTS								
Insecticide								
FURDAN 10g (carbofuran)	8	0.21	0.115 a/	0	1.0	10.0 lb	.69	6.90
SEVIN 80s (carbaryl)	500	1.00	0.011	0	0.8	1.0 lb	1.73	1.73
MOCAP 10g (ethoprop)	61.5	1.00	0.077 a/	1836 c/	1.5	15.0 lb	.52	7.80
Herbicide								
VERNAM 10 G (vernolate)	1625	9.60	0.137	11 c/	2.0	20.0 lb	.29	5.80
LASSO 15g (alachlor)	1200	2.30	0.150	0	2.0	13.0 lb	.57	7.60
Enide 50 WP + Premerge 3 lb/gal.								
(diphenamid,	970	25.00	0.370	4 c/	1.0	2.0 lb	2.75	5.50
dinoseb)	5	0.40	0.063	19 c/	0.5	.67 qt	1.81	1.21
Fungicide								
BOTRAN (dichloran)	4040	0.30 e/	0.080 g/	0 g/	0.1	.2 lb	?	
BENLATE (benomyl)	9590	0.50	0.500 h/	0 g/	1.25	2.5 lb	7.85	19.62
GROWTH CNTL								
KYLAR 85w (succinic acid)	8400	0.36 h/	0.080 g/	0 g/	0.2	1.0 lb	14.00	14.00

Table E-1--Pesticide Application, 1990

Crop and Material	Toxicity LD[1] mg/kg	Toxicity LC[2] mg/l	Persistance In Soil, Yrs.[3]	Ecological Magnification[4]	Active Ingredient Per Acre, lbs.[5]	Formulation Amount Unit/AC	Formulation Price[6] $/Unit	Cost of Application $/Ac.
F-C TOBACCO								
Insecticide P.B. (disulfoton)	2	0.04	0.038[b]	0[b]	.6	4.0 lb	.54	2.16
Insecticide FLD ORTHENE 75 SP (acephate)	945[d]	2.00[d]	0.200	0	1.0	1.0 lb	5.95	5.95
Herbicide PAARLAN 6ec (isopropalin)	5000	0.50	0.411	1836[c]	1.5	2.0 pt	7.79	15.58
Fungicide FERBAM 76 wp Ferbam)	17000	12.60	0.080[g]	0[c]	0.8	0.8	1.00	.80
Nematicide TELONE C-17 (dichloropropene, chloropicrin)	375[d]/ 5	0.08[f]/ 0.01	0.800[g]/ 0.080[g]	0[c]/ 2818[c]	1.5 / 0.3	10.5 gal	5.90	61.95
GROWTH CNTL ROYAL MH 30 (malic hydrazide)	4650[e]	11,748[f]	0.080[g]	0[c]	4.5	1.5 gal	7.65	11.47
OFFSHOOT T-85 (fatty alcohol)	--	--	--	--	12.0	2.0 gal	7.26	14.52

NOTES:

1/ Acute oral toxity to 50% of test rats.

2/ Lethal 96-HR concentration to 50% of test fish, usually trout, catfish, or bluegill.

3/ Time required for 90% or more of applied pesticide to disappear from site of application. All value of 1/, 2/, and 3/ are from Control of Water Polution from Cropland Vol. I (ARS, USDA, EPA: NTIS, November, 1975) pp. 48-53 im;ess noted.

4/ Pesticide concentration in fish divided by concentration in water, determined using the model ecology system developed by R. L. Metcalf and J. R. Sanborn. Source is "Pesticides and Environmental Quality in Illinois." Illinois Natural History Survey Bulletin Vol. 31, Art. 9. August, 1975, unless noted.

5/ Determined through telephone interview with pesticide specialists, School of Agriculture and LIfe Sciences, North Carolina State University at Raleigh and from 1977 North Carolina Agricultural Chemicals Manual School of Agriculture and Life Sciences, NCSU.

6/ 1977 prices as used in Planning for Profit budgets.

a/ From Klaus F. Alt, "An Economic Analysis of Held Crop Production, Insecticide use and Soil Erosion in a Subbasin of the Iowa River," Unpublished Doctoral Thesis, Iowa State University, 1976. pg. 46. Expressed as Half-Life.

b/ From Jerome B. Weber, "The Pesticide Scorecard," Environmental Science and Technology, Vol. II, No. 8, August, 1977. pg. 759.

c/ Estimated from the equation

$$\log EM = .03 - .98 \log sol$$

where log EM = the logarithm 10 of ecological magnification
log sol = the logarithm 10 of water solubility in ppb.
obtained by fitting to known values as described in METCALF and Sanborn (1975) pg. 401.

d/ From J. R. Sanborn The Fate of Select Pesticides in the Aquatic Environment, EPA 660/3-74--25 (Washington; U.S.G.PO., December, 1974) pg. 43.

e/ From The Pesticide Manual, British Crop Protection Council.

f/ Estimated from the equation

$$\log LC\ 50 = -1.6074 + 1.50308 \log sol$$

where log LC 50 = the logarithm 10 of LC 50, mg/0
log sol = the logarithm 10 of intersolubility in ppm.

g/ Assumed value in the absense of information for longanity, value of 1 month assumed. For LD 50 of cholropicrin, assumed value of 5 due to characterization of "toxic." For ecological magnification, value of zero assumed where no water solubility was available.

h/ From Pesticide Index.

APPENDIX F

GROSS SOIL EROSION, CHOWAN BASIN

Table F-1 Gross soil erosion, Chowan Basin[1/]

SPG	No Practice	Contour Farming	Field SC A[2/]	Field SC B[3/]	Contour SC A[4/]	Contour SC B[5/]
	tons/acre					
10	56.2	28.2	19.7	22.5	14.0	19.7
11	91.2	54.5	36.4	41.0	27.3	36.4
12	74.0	37.0	25.9	29.6	18.5	25.9
13	12.0	7.2	4.2	5.4	3.7	4.8
14	53.9	26.9	18.9	21.5	13.5	18.9
15	8.4	5.1	2.9	3.9	2.5	3.5
16	138.4	83.1	55.4	62.3	41.5	55.4
17	122.1	97.7	61.0	79.3	48.8	61.0
18	30.7	16.8	10.7	12.8	8.2	11.3
19	120.5	62.1	43.2	49.2	31.1	43.2
20	116.4	58.2	40.7	46.6	29.1	40.7
21	0	0	0	0	0	0
22	23.4	12.9	8.1	10.0	6.4	8.8
23	22.3	13.3	7.8	9.9	6.7	8.9
24	13.0	7.8	4.6	5.9	3.9	5.0
25	15.2	9.1	5.4	6.8	4.5	6.0
26	15.7	9.5	5.4	7.0	4.6	6.3
27	13.3	8.0	4.6	6.0	4.0	5.3
28	10.2	6.2	3.6	4.6	3.1	4.1
29	199.5	108.1	74.0	86.8	54.1	74.0
30	44.5	22.3	15.6	16.7	17.8	15.6
31	.5	.3	.2	.2	.2	.2

1/ Soil losses shown do not include the effects of the crop practice factor, C, and are thus equivalent to bare-ground or fallow soil lost.
2/ Field stripcropping with meadow strips.
3/ Field stripcropping with small grain winter cover.
4/ Contour stripcropping with meadow strips.
5/ Contour stripcropping with small grain winter cover.

Table F-2 Terraced gross soil erosion, Chowan Basin[1/]

SPG	No Practice	Contour Farming	Field SC A[2/]	Field SC B[3/]	Contour SC A[4/]	Contour SC B[5/]
	tons/acres					
10	22.7	11.4	8.0	9.1	5.7	8.0
11	18.9	11.4	7.6	8.5	5.7	7.6
12	33.6	16.8	11.8	13.4	8.4	11.8
13	15.0	9.0	5.2	6.7	4.5	6.0
14	30.2	15.1	10.6	12.1	7.6	10.6
15	13.1	7.8	4.6	5.9	3.9	5.2
16	0	0	0	0	0	0
17	15.6	12.5	7.8	10.1	6.2	7.8
18	16.5	8.8	5.8	6.9	4.4	6.0
19	21.1	10.6	7.4	8.5	5.3	7.4
20	31.6	15.8	11.0	12.6	7.9	11.0
21	0	0	0	0	0	0
22	15.5	8.6	5.4	6.6	4.3	5.8
23	30.6	18.4	10.7	13.8	9.2	12.3
24	0	0	0	0	0	0
25	11.1	6.6	3.8	5.0	3.4	4.4
26	30.9	18.5	10.8	13.9	9.3	12.3
27	32.6	19.5	11.4	14.7	9.8	13.0
28	0	0	0	0	0	0
29	32.7	16.4	11.4	13.1	8.2	11.4
30	15.6	7.8	5.4	6.2	3.9	5.5
31	0	0	0	0	0	0
32	0	0	0	0	0	0

1/ Soil losses shown do not include the effects of the crop practice factor, C, and are thus equivalent to bare-ground or fallow soil lost.
2/ Field stripcropping with meadow strips.
3/ Field stripcropping with small grain winter cover.
4/ Contour stripcropping with meadow strips.
5/ Contour stripcropping with small grain winter cover.

APPENDIX G

LP SOLUTION SUMMARIES

ROWS CHOWAN LP RESULTS,SPG,SUMMARY SPGS Without Plan Solution Table G-1

	10	11	12	13	14	15	16	17	18	19
COST	19713610.	9143624.	859376.	516035.	188680.	332604.	54823.	1625664.	42935690.	3047113.
FERTN	5965400.	6827468.	833987.	567814.	194026.	362221.	47946.	524648.	6697395.	308962.
FERTP	5724292.	2492970.	274209.	209981.	68235.	118540.	16957.	193649.	12827270.	395581.
FERTK	5514949.	2477350.	514392.	277596.	126502.	217026.	12279.	384019.	16787820.	642701.
ALT1	1557315.	164342.	30821.	67485.	8122.	4691.	649.	49215.	5439271.	542374.
WEBER2	3121313.	868788.	67214.	70432.	15782.	15795.	10408.	94354.	8638904.	881332.
BTUFUEL	284303600.	122004500.	14329400.	6390274.	3173506.	5644205.	790004.	22216840.	834521300.	78500730.
BTUFERT	405999100.	379042000.	55858380.	25056190.	9590703.	17615020.	2171280.	33892730.	869720000.	67736810.
BTUPEST	82943950.	16759460.	1617743.	1529216.	388539.	335422.	183073.	2740296.	199699100.	20318320.
EPOSION	1931420.	1248996.	103026.	3418.	16828.	3583.	33504.	201806.	21219440.	850920.
PROFIT	23558090.	7743903.	582466.	457989.	116290.	189085.	44538.	1466392.	50852800.	3477810.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	17955.	14261.	0.	2378.	0.	0.	0.	0.	0.	0.
SG10	121521.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	59618.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	12600.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	3969.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	2923.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	5348.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	585.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	10551.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	190930.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	18093.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	1216719.	1005772.	72810.	115799.	9183.	31544.	39117.	42249.	5032756.	223931.
CSIL	0.	104446.	0.	19767.	0.	0.	0.	0.	0.	0.
WHET	1300755.	1243430.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	2434487.	143429.	31340.	12353.	7745.	4564.	0.	20662.	1123625.	88621.
SORG	0.	648234.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	21162480.	7117828.	114426.	0.	0.	0.	0.	2294445.	11234340.	706158.
PNUT	0.	0.	0.	0.	0.	0.	0.	0.	328778200.	28848300.
HAYB	0.	0.	17972.	5430.	4450.	7853.	0.	8968.	0.	0.
CONTOUR	33349.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	20	21	22	23	24	25	26	27	28	29
COST	4972974.	0.	13297790.	32516110.	182898.	9348570.	16182260.	13543330.	151440.	0.
FERTN	1046225.	0.	1749456.	7667278.	199453.	919351.	5374043.	2908452.	57002.	0.
FERTP	961807.	0.	1158496.	8527507.	54137.	1767338.	7956831.	7664863.	25791.	0.
FERTK	1459673.	0.	1489178.	9833455.	113973.	2978276.	9922082.	12422800.	19730.	0.
ALT1	748554.	0.	1964679.	5383525.	0.	1437616.	3601954.	2898597.	41842.	0.
WEBER2	1137807.	0.	3116518.	9533803.	0.	2295486.	5716021.	4761156.	61601.	0.
BTUFUEL	95092680.	0.	496695000.	624986800.	4709960.	185368500.	291299300.	243042500.	2619963.	0.
BTUFERT	105252200.	0.	250633300.	721837500.	10973910.	181391900.	421648300.	322332900.	3918641.	0.
BTUPEST	28501710.	0.	71892670.	209746700.	0.	53078830.	148198100.	124206200.	1574356.	0.
EROSION	1311398.	0.	593691.	1962856.	2279.	296770.	1121901.	815275.	8015.	0.
PROFIT	5651150.	0.	13681000.	40756430.	72287.	6439494.	25762360.	22211000.	95578.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG1C	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG2C	29816.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	69458.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	228553.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	2849.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	51727.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	183676.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	149531.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	2082.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	810537.	0.	1356741.	6031552.	0.	745173.	4367926.	2370702.	46090.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	391280.	0.	305110.	4354692.	0.	250802.	5057420.	4874197.	21305.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	1326194.	0.	1854230.	5346690.	0.	128259.	0.	0.	0.	0.
PNUT	25393310.	0.	103911100.	135940300.	0.	64380120.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	4844.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	30	31	32	33	34	35	36	37	38	39
COST	1017967.	4546220.	0.	0.	0.	0.	0.	0.	0.	0.
FERTN	100833.	3323958.	0.	0.	0.	0.	0.	0.	0.	0.
FERTP	75661.	1078828.	0.	0.	0.	0.	0.	0.	0.	0.
FERTK	88797.	1691136.	0.	0.	0.	0.	0.	0.	0.	0.
ALT1	164780.	636218.	0.	0.	0.	0.	0.	0.	0.	0.
WEBER2	261255.	702697.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFUEL	19253900.	50587150.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFERT	18306750.	14423880.	0.	0.	0.	0.	0.	0.	0.	0.
BTUPEST	6168349.	16765970.	0.	0.	0.	0.	0.	0.	0.	0.
EROSION	116605.	2916.	0.	0.	0.	0.	0.	0.	0.	0.
PROFIT	451411.	5822198.	0.	0.	0.	0.	0.	0.	0.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	6234.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	9322.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SGB1	0.	19836.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	75096.	4082054.	0.	0.	0.	0.	0.	0.	0.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	31180.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	188257.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PNUT	4698192.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

ROWS CHOWAN LP RESULTS,SPG,SUMMARY SPGS Erosion Solution Without Terrace Table G-2

	10	11	12	13	14	15	16	17	18	19
COST	20770490.	9961710.	3326347.	371391.	250038.	417163.	119511.	1689506.	41952110.	3354890.
FERTN	4429495.	6844211.	917049.	111677.	191584.	38854.	120439.	506669.	6458129.	1075688.
FERTP	5639577.	1921382.	433870.	163851.	54183.	104682.	35643.	218535.	12843990.	635231.
FERTK	5482372.	2735392.	531111.	139544.	54303.	110777.	47398.	362650.	15689120.	829089.
ALTI	1110409.	1167148.	129681.	37200.	17713.	34812.	655.	50434.	5018244.	277746.
WEBER2	3523636.	1319983.	384506.	110119.	84617.	151725.	10494.	110531.	8605249.	670059.
BTUFUEL	263236800.	126591000.	40761340.	5183492.	3743952.	5709941.	1933814.	21983260.	818672100.	57367180.
BTUFERT	363435500.	435998900.	62491720.	8866485.	8441716.	7564324.	5452491.	31631160.	858179400.	79452160.
BTUPEST	91424700.	29998460.	7101770.	2700874.	1021521.	3811487.	184690.	3028234.	197208000.	14890970.
EROSION	747166.	402847.	108282.	4273.	15138.	6315.	5882.	66256.	1760264.	341249.
PROFIT	23830780.	9702008.	2802061.	404931.	106244.	282564.	56192.	1387775.	47414250.	2709271.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	112678.	48190.	7284.	3969.	2923.	5348.	0.	0.	30286.	0.
SG10	121521.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	59618.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	12600.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	3969.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	2923.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	5348.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	1619.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	10917.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	190930.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	18693.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	1813754.	3006624.	72810.	91110.	9193.	31544.	39462.	87855.	5032757.	225973.
CSIL	0.	124213.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	453692.	132586.	0.	0.	0.	0.	17451.	36260.	0.	195429.
SOYB	2765419.	143429.	44600.	89328.	7745.	101575.	0.	20871.	1123625.	157019.
SORG	0.	0.	502567.	0.	145667.	0.	0.	0.	0.	0.
FCTB	21162480.	7117828.	4472336.	0.	0.	0.	0.	2294445.	6095254.	706158.
PNUT	0.	0.	0.	0.	0.	0.	0.	0.	33362990.	12159160.
HAYB	0.	27124.	0.	0.	0.	0.	618.	4773.	0.	5800.
CONTOUR	0.	245.	5317.	0.	0.	0.	75.	2051.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	60573.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	2622.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	1544.	8856.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	20	21	22	23	24	25	26	27	28	29
COST	5284121.	0.	13354780.	37211020.	0.	10642380.	17953070.	15136560.	372812.	0.
FERTN	2409381.	0.	1747604.	11523600.	0.	919351.	5374043.	2978452.	158335.	0.
FERTP	1191327.	0.	1157897.	9566718.	0.	1966922.	7956831.	7664863.	67858.	0.
FERTK	1860319.	0.	1488688.	10601210.	0.	3377443.	9922082.	12422800.	49762.	0.
ALTI	491519.	0.	1790332.	3760185.	0.	1415342.	1534976.	1043011.	59670.	0.
WEBER2	973819.	0.	3092918.	8723453.	0.	2524407.	5429481.	4503943.	124859.	0.
BTUFUEL	96925750.	0.	494498800.	670946800.	0.	208337700.	281277100.	234046300.	5582492.	0.
BTUFERT	152592000.	0.	250622600.	884238300.	0.	201047900.	421648300.	322332900.	9702601.	0.
BTUPEST	21757130.	0.	71034400.	203436500.	0.	57831690.	137894200.	114956800.	3110879.	0.
EROSION	548938.	0.	437911.	1023820.	0.	251348.	383429.	193778.	6333.	0.
PROFIT	4648874.	0.	13629130.	38836270.	0.	7043902.	23991550.	20617360.	184167.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	1755.	0.	0.	86913.	0.	11943.	143270.	128607.	2262.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	29816.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	69458.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	228553.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	56162.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	183676.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	149531.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	4524.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	811537.	0.	1355227.	5931550.	0.	745173.	4367926.	2370702.	128025.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	281949.	0.	0.	1426818.	0.	0.	0.	0.	0.	0.
SOYB	193124.	0.	305110.	3954357.	0.	250802.	5057420.	4874197.	38000.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCT3	1326194.	0.	1854230.	6127875.	0.	128259.	0.	0.	0.	0.
PNUT	20479980.	0.	103958100.	143649500.	0.	74370840.	0.	0.	0.	0.
HAYB	14728.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	12907.	0.	24215.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	5446.	92942.	0.	22277.	81813.	41848.	4524.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	12108.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	30	31	32	33	34	35	36	37	38	39
COST	1536159.	1044405.	0.	0.	0.	0.	0.	0.	0.	0.
FERTN	193241.	1062675.	0.	0.	0.	0.	0.	0.	0.	0.
FERTP	127112.	344904.	0.	0.	0.	0.	0.	0.	0.	0.
FERTK	145935.	541661.	0.	0.	0.	0.	0.	0.	0.	0.
ALTI	215489.	203400.	0.	0.	0.	0.	0.	0.	0.	0.
WEBER2	304670.	224653.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFUEL	28221750.	15172800.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFERT	28632720.	46113400.	0.	0.	0.	0.	0.	0.	0.	0.
BTUPEST	9255398.	5360081.	0.	0.	0.	0.	0.	0.	0.	0.
EROSION	109211.	932.	0.	0.	0.	0.	0.	0.	0.	0.
PROFIT	615179.	2270397.	0.	0.	0.	0.	0.	0.	0.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	2928.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	9973.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	9322.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	150489.	1305040.	0.	0.	0.	0.	0.	0.	0.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	49187.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	188257.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PNUT	6701731.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	5856.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

ROWS CHOWAN LP RESULTS,SPG,SUMMARY SPGS No-Tillage Solution Table G-3

	10	11	12	13	14	15	16	17	18	19
COST	19825290.	9317355.	923744.	516035.	189284.	334506.	133847.	1274994.	42933850.	3847113.
FERTN	6350028.	6389353.	861325.	567814.	194026.	362221.	142106.	158440.	6697077.	308962.
FERTP	5758229.	2458013.	294231.	209981.	68235.	118540.	39721.	89019.	12827290.	395561.
FERTK	5543230.	2704838.	468746.	277596.	126902.	217026.	53668.	174758.	16787680.	642711.
ALTI	1802466.	560159.	64544.	67485.	12022.	16981.	14706.	58975.	5439292.	542374.
WEBER2	3114990.	940854.	130104.	70432.	16837.	19118.	14209.	79696.	8638558.	681382.
BTUFUEL	283613600.	119404600.	14960220.	6390274.	3172970.	5642518.	1878302.	14942450.	834502600.	78500730.
BTUFERT	417166300.	396425900.	54988560.	25056190.	9590703.	17615020.	6033208.	14427980.	869704700.	67736810.
BTUPEST	83023550.	19834640.	2330758.	1529216.	419365.	432552.	294163.	2896461.	199698700.	20318320.
EROSION	1670956.	703293.	111492.	3418.	15481.	2918.	44731.	166840.	2121938.	850920.
PROFIT	23292620.	7844944.	611664.	457989.	115686.	187183.	51799.	1344578.	50848750.	3477810.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	30383.	29799.	3096.	2378.	162.	511.	585.	822.	0.	0.
SG10	121521.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	59618.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	12600.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	3969.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	2923.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	5348.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	1619.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	3077.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	190930.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	18693.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CORN	1216719.	1005772.	72810.	115799.	9183.	31544.	39117.	42249.	5032757.	223931.
CSIL	0.	104446.	0.	19767.	0.	0.	0.	0.	0.	0.
WHET	1444424.	1062362.	2322.	0.	0.	0.	35077.	0.	0.	0.
SOYB	2371339.	155888.	31329.	12353.	7745.	4564.	0.	20662.	1123625.	68621.
SORG	0.	515994.	132241.	0.	0.	0.	0.	0.	0.	0.
FCTB	21162480.	7123520.	115581.	0.	0.	0.	0.	2294445.	11227500.	700158.
PNUT	0.	0.	0.	0.	0.	0.	0.	0.	328784600.	28648300.
HAYB	0.	17262.	14522.	5430.	4450.	7853.	0.	0.	0.	0.
CONTOUR	39035.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	20	21	22	23	24	25	26	27	28	29
COST	4617651.	0.	13297790.	32516110.	0.	9914364.	16487480.	13543330.	151448.	0.
FERTN	1046225.	0.	1749456.	7667278.	0.	919351.	5374043.	2908452.	57002.	0.
FERTP	1020549.	0.	1158496.	8527507.	0.	1865362.	7956832.	7664863.	25791.	0.
FERTK	1497436.	0.	1489178.	9833455.	0.	3174323.	9922083.	12422800.	19730.	0.
ALT1	717863.	0.	1964679.	5383525.	0.	1511264.	2466854.	2898597.	41842.	0.
WEBER2	1137667.	0.	3116518.	8583803.	0.	2419650.	5558696.	4761156.	61601.	0.
BTUFUEL	86886490.	0.	496695000.	624986800.	0.	197097600.	277647300.	243042500.	2619963.	0.
BTUFERT	99672540.	0.	250633300.	721837500.	0.	191045700.	421648300.	322332900.	3918641.	0.
BTUPEST	27677100.	0.	71892670.	209746700.	0.	55835020.	142540800.	124206200.	1574356.	0.
EROSION	1321678.	0.	593691.	1962856.	0.	310057.	752188.	815275.	8015.	0.
PROFIT	5504212.	0.	13681000.	40756430.	0.	6805995.	25457150.	22211000.	95578.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	78663.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	29816.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	69458.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	228553.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	53905.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	183676.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	149531.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	2082.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	800537.	0.	1356741.	6031552.	0.	745173.	4367926.	2370702.	46090.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	461979.	0.	305110.	4354692.	0.	250802.	5057420.	4874197.	21305.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	1326194.	0.	1854230.	5346690.	0.	128259.	0.	0.	0.	0.
PNUT	20479580.	0.	103911100.	135940300.	0.	69286990.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	30	31	32	33	34	35	36	37	38	39
COST	1017967.	4546220.	0.	0.	0.	0.	0.	0.	0.	0.
FERTN	100833.	3323958.	0.	0.	0.	0.	0.	0.	0.	0.
FERTP	75661.	1078828.	0.	0.	0.	0.	0.	0.	0.	0.
FERTK	88797.	1691136.	0.	0.	0.	0.	0.	0.	0.	0.
ALT1	164780.	636218.	0.	0.	0.	0.	0.	0.	0.	0.
WEBER2	261255.	702697.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFUEL	19253500.	50587150.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFERT	16306750.	144238800.	0.	0.	0.	0.	0.	0.	0.	0.
BTUPEST	6168349.	16765870.	0.	0.	0.	0.	0.	0.	0.	0.
EROSION	116605.	2916.	0.	0.	0.	0.	0.	0.	0.	0.
PROFIT	451411.	5822198.	0.	0.	0.	0.	0.	0.	0.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	6234.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	9322.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	19836.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	75096.	4082054.	0.	0.	0.	0.	0.	0.	0.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	31180.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCTB	188257.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PNUT	4698192.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

ROWS CROWAN LP RESULTS,SPG,SUMMARY SPGS Chisel Plow Solution Table G-4

	10	11	12	13	14	15	16	17	18	19
COST	19713610.	9143624.	859376.	516035.	188680.	332604.	54823.	1625663.	42935690.	3847113.
FERTN	5965400.	2827468.	823987.	567814.	194026.	362221.	47946.	524648.	8697395.	328962.
FERTP	5724292.	2492970.	274209.	209981.	68235.	118540.	16957.	193649.	12827270.	395581.
FERTK	5514949.	2477350.	514392.	277596.	126902.	217026.	12279.	384019.	16787820.	642701.
ALTI	1557315.	164342.	30621.	67485.	8122.	4691.	649.	49215.	5439271.	542374.
HERBER2	3121314.	868768.	67214.	70432.	15782.	15795.	10408.	94354.	8638904.	881332.
BTUFUEL	284303600.	122004500.	14329400.	6390274.	3173535.	5644205.	790004.	22216830.	334521300.	18500730.
BTUFERT	439999100.	379042512.	52858360.	25026150.	9990703.	17615020.	2171280.	33692720.	869720000.	67730810.
BTUPEST	82943950.	16759460.	1617744.	1529216.	368559.	635422.	183073.	2740296.	199699100.	20318320.
EROSION	1213402.	1160140.	60747.	2199.	9005.	2308.	18165.	140004.	2109826.	847435.
PROFIT	23556090.	7743904.	582466.	457989.	116269.	185089.	44538.	1466391.	50652300.	3477810.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	17955.	14261.	0.	2378.	0.	0.	0.	0.	0.	0.
SG10	121521.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	59618.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	12600.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	3969.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	2923.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	5348.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	585.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	10551.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	190930.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	18693.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CORN	1210719.	1035772.	72810.	115799.	9183.	31544.	39117.	42249.	5032756.	223931.
CSIL	0.	104446.	0.	19767.	0.	0.	0.	0.	0.	0.
WHET	1300755.	1243430.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	2454487.	143429.	31340.	12353.	7745.	4564.	0.	20662.	1123625.	58621.
SCRG	0.	648234.	0.	0.	0.	0.	0.	0.	0.	0.
FCIB	21162480.	7117828.	114426.	0.	0.	0.	0.	2294445.	11234360.	726196.
PNUT	0.	0.	0.	0.	0.	0.	0.	0.	328773200.	26846300.
HAYB	0.	0.	17972.	5430.	4450.	7853.	0.	8968.	0.	0.
CONTOUR	33349.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	61374.	11107.	2562.	420.	561.	729.	585.	2052.	65573.	5039.
MINTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	20	21	22	23	24	25	26	27	28	29
COST	4972974.	0.	13297790.	32516110.	182898.	9348570.	16182260.	13543530.	151446.	0.
FERTN	1046225.	0.	1749456.	7667278.	199453.	919351.	5374043.	2508452.	57002.	0.
FERTP	961807.	0.	1158496.	8527507.	54137.	1767338.	7956831.	7664863.	25791.	0.
FERTK	1459673.	0.	1489178.	9833455.	113973.	2978270.	9922082.	12422800.	19730.	0.
ALTI	748954.	0.	1964679.	5383525.	0.	1437016.	3001954.	2898597.	41842.	0.
WEBERZ	1187807.	0.	3116518.	8583803.	0.	2295486.	5716021.	4761156.	61601.	0.
BTUFUEL	95092660.	0.	496695000.	624980800.	4709960.	185366500.	291259300.	243042500.	2619963.	0.
BTUFERT	105252200.	0.	250633300.	721837500.	1097390.	181391900.	421648300.	322332900.	3918641.	0.
BTUPEST	28501710.	0.	71892670.	209746700.	0.	53078830.	148198100.	124206200.	1574356.	0.
EROSION	1311398.	0.	591270.	1962856.	2279.	287859.	1113820.	811090.	7526.	0.
PROFIT	5651150.	0.	13681000.	40756430.	72287.	6439494.	25762360.	22211000.	95578.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	29816.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	69458.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	228553.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	2849.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	51727.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	183678.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	149531.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	2062.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CORN	800537.	0.	1356741.	6031552.	0.	745173.	4367926.	2370702.	46090.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	391280.	0.	305110.	4354692.	0.	250802.	5057420.	4874197.	21305.	0.
SORG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FCIB	1326194.	0.	1854230.	5346690.	0.	126259.	0.	0.	0.	0.
PNUT	25393310.	0.	103911100.	135940300.	0.	64380120.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	4844.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	24215.	0.	0.	22271.	65813.	41848.	1629.	0.
MULTER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	30	31	32	33	34	35	36	37	38	39
COST	1017907.	4546220.	0.	0.	0.	0.	0.	0.	0.	0.
FERTN	100853.	3323958.	0.	0.	0.	0.	0.	0.	0.	0.
FERTP	75661.	1078823.	0.	0.	0.	0.	0.	0.	0.	0.
FERTK	38797.	1691136.	0.	0.	0.	0.	0.	0.	0.	0.
ALTI	16478.	636218.	0.	0.	0.	0.	0.	0.	0.	0.
WEBER2	261255.	732697.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFUEL	19253900.	50587150.	0.	0.	0.	0.	0.	0.	0.	0.
BTUFERT	18306750.	144238800.	0.	0.	0.	0.	0.	0.	0.	0.
BTUPEST	6168349.	16765870.	0.	0.	0.	0.	0.	0.	0.	0.
EROSION	116035.	2916.	0.	0.	0.	0.	0.	0.	0.	0.
PROFIT	451411.	5822198.	0.	0.	0.	0.	0.	0.	0.	0.
TERRACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTILL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG30	6234.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG31	0.	9522.	0.	0.	0.	0.	0.	0.	0.	0.
SG76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SG81	0.	19836.	0.	0.	0.	0.	0.	0.	0.	0.
CGRN	75096.	4082054.	0.	0.	0.	0.	0.	0.	0.	0.
CSIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WHET	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOYB	31180.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SCRG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FLIB	188257.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PNUT	4698192.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAYB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONTOUR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
STRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHISEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINTIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MINSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRIP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

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